

SELECTED  
 **WATER  
RESOURCES  
ABSTRACTS**



**VOLUME 7, NUMBER 17**  
SEPTEMBER 1, 1974

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SELECTED WATER RESOURCES ABSTRACTS is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the National Technical Information Service (NTIS), U.S. Department of Commerce. NTIS was established September 2, 1970, as a new primary operating unit under the Assistant Secretary of Commerce for Science and Technology to improve public access to the many products and services of the Department. Information services for Federal scientific and technical report literature previously provided by the Clearinghouse for Federal Scientific and Technical Information are now provided by NTIS.

SELECTED WATER RESOURCES ABSTRACTS is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U.S. Department of the Interior, Washington, D. C. 20240.

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# **SELECTED WATER RESOURCES ABSTRACTS**

**A Semimonthly Publication of the Water Resources Scientific Information Center,  
Office of Water Resources Research, U.S. Department of the Interior**



**VOLUME 7, NUMBER 17  
SEPTEMBER 1, 1974**

W74-08701 - W74-09250

The Secretary of the U. S. Department of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through August 31, 1978.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

## FOREWORD

**Selected Water Resources Abstracts**, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus**. Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

WRSIC IS NOT PRESENTLY IN A POSITION TO PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas.

Additional "centers of competence" have been established in cooperation with the Environmental Protection Agency. A directory of the Centers appears on inside back cover.

Supplementary documentation is being secured from established discipline-oriented abstracting and indexing services. Currently an arrangement is in effect whereby the BioScience Information Service of Biological Abstracts supplies WRSIC with relevant references from the several subject areas of interest to our users. In addition to Biological Abstracts, references are acquired from Bioresearch Index which are without abstracts and therefore also appear abstractless in SWRA. Similar arrangements with other producers of abstracts are contemplated as planned augmentation of the information base.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the

Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangements of this bulletin are welcome.

Water Resources Scientific Information Center  
Office of Water Resources Research  
U.S. Department of the Interior  
Washington, D. C. 20240

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#### 02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

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Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

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Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

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**07 RESOURCES DATA**

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**ABSTRACT SOURCES**

# SELECTED WATER RESOURCES ABSTRACTS

## 2. WATER CYCLE

### 2A. General

**FORECASTING CHANGES IN WATER BALANCE UNDER INFLUENCE OF HUMAN ACTIVITY (PROGNOZIROVANIYE IZMENENIY VODNOGO BALANSA POD VLIYANIYEM KHOZYAYSTVENNOY DEYATEL'NOSTI).**  
For primary bibliographic entry see Field 4A.  
W74-08709

**HYDROGEOLOGY IS MORE THAN A CLASSICAL SCIENCE.**  
Wisconsin Univ., Madison. Water Resources Management Program.  
D. Stephenson.  
Ground Water, Vol 12, No 3, p 148-151, May-June 1974. 1 tab, 3 ref.

Descriptors: \*Hydrogeology, \*Education, Environment, Management, Planning, Social aspects, Colleges, Universities, Water resources.

Uses of land and water resources create conflicts between natural and human environments. These conflicts are generally not discussed as part of a classical approach to geologic education. The need to increase non-earth science training simultaneous with traditional training is discussed. The benefits to be gained will be welcomed by both students and their potential employers. An interdisciplinary, project-oriented course was developed at the University of Wisconsin (Madison Campus) which encompasses both theory and practice in application of hydrogeologic concepts. Case-history presentations are used to supplement basic studies in water-, soil-, rock-, and people-interrelationships--with emphasis on groundwater. (Knapp-USGS)  
W74-09090

**PROBLEMS OF THE REGIME AND INVESTIGATION OF LAKES AND RESERVOIRS (VOPROSY REZHIMA I ISSLEDOVANIYA OZER I VODOKHRANILISHCH).**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
For primary bibliographic entry see Field 2H.  
W74-09100

**WATER BALANCE OF LAKE BAYKAL (VODNY BALANS OZ. BAYKAL).**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
For primary bibliographic entry see Field 2H.  
W74-09101

**VOLUME OF WATER IN RIVERS, LAKES, AND RESERVOIRS OF THE SOVIET UNION (OB'YEM VODY V REKAKH, OZERAKH I VODOKHRANILISHCHAKH SOVETSKOGO SOYUZA).**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
For primary bibliographic entry see Field 2H.  
W74-09111

**WATER BALANCE OF WORLD LAKES AND RESERVOIRS (VODNY BALANS OZER I VODOKHRANILISHCH ZEMNOGO SHARA).**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
For primary bibliographic entry see Field 2H.  
W74-09112

**SEISMIC REFRACTION ANALYSIS OF WATERSHED MANTLE RELATED TO SOIL, GEOLOGY, AND HYDROLOGY.**  
Forest Service (USDA), Rapid City, S. Dak. Rocky Mountain Forest and Range Experiment Station.  
For primary bibliographic entry see Field 2G.  
W74-09199

**PARTIAL AREA HYDROLOGY AND ITS APPLICATION TO WATER RESOURCES.**  
Agricultural Research Service, University Park, Pa. Northeast Watershed Research Center.  
E. T. Engman.  
Water Resources Bulletin, Vol 10, No 3, p 512-521, June 1974. 4 fig, 22 ref.

Descriptors: \*Rainfall-runoff relationships, \*Hydrograph analysis, Urban hydrology, Land use, Storm runoff, Infiltration, Hydrogeology, Soil water, Model studies, Remote sensing, Water quality.  
Identifiers: Partial area hydrology.

Using a concept known as partial area hydrology, watershed areas are separated into hydrologically active and passive subareas. The literature relating to the development of the partial area concept is reviewed briefly and the relationship of partial area hydrology to geology, soils, and micrometeorology is illustrated. The potential application of partial area hydrology is discussed with respect to present hydrologic techniques, future hydrologic models, urban hydrology, water quality, and water management. Certain regions within a watershed contribute runoff to the storm hydrograph while other areas act as recharge or storage zones. Whether an area contributes to runoff or to the groundwater depends on its physical position with respect to the channel, its soil properties, and the storm characteristics. Soil maps and air photos offer the best tools for identifying and delineating the partial areas in a watershed. On air photos, dark tones indicating poor drainage and light tones indicating erosion could indicate contributing areas. Other forms of remote sensing offer a lot of potential for the future identification of partially contributing areas. The most promising of these is radar imagery. (Knapp-USGS)  
W74-09200

**A SENSITIVITY AND ERROR ANALYSIS OF PROCEDURES USED FOR ESTIMATING EVAPORATION.**  
Maryland Univ., College Park. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 2D.  
W74-09201

**EFFECT OF URBANIZATION ON RUNOFF FROM SMALL WATERSHEDS.**  
Arizona Univ., Tucson. Water Resources Research Center.  
For primary bibliographic entry see Field 4C.  
W74-09245

### 2B. Precipitation

**A NOTE ON THE REMARKABLY LOW RAINFALL OF THE SUDAN ZONE IN 1913.**  
Cambridge Univ. (England). Dept. of Geography.  
A. T. Grove.  
Savanna, Vol 2, No 2, p 133-138, December 1973. 2 fig, 23 ref.

Descriptors: \*Isohyets, \*Droughts, \*Africa, \*Climatic data, \*Dry seasons, Rainfall, Livestock, Rivers, Lakes, Flood discharge, Water levels Regional analysis.  
Identifiers: Sudan zone, Inter-tropical discontinuity, Nile River, Senegal, Ethiopia.

The Sudan zone is a latitudinal belt running across Africa from Senegal to Ethiopia having a mean annual rainfall ranging between 16 and 40 inches. A dry period occurs from October to April with most of the rain coming during the summer months. The years between the turn of the century and World War I were considerably drier than periods before or after and despite scanty rainfall records, 1913 appeared to be particularly dry year. During this year many areas received from 20 to 50 percent of their mean annual rainfall with ranges of 5 to 30 inches within the zone. From available data the concluded cause of the drought period was a shift of isohyets 150 km. or more to the south of their mean positions bringing about an influence of the desert climate. (Mastic-Arizona)  
W74-08759

**A JEEP-MOUNTED RAINFALL SIMULATING INFILTROMETER.**  
Northern Arizona Univ., Flagstaff.  
For primary bibliographic entry see Field 7B.  
W74-08766

**PREDICTION OF DEW POINT TEMPERATURE, SOLAR RADIATION AND WIND MOVEMENT DATA FOR SIMULATION AND OPERATIONS RESEARCH MODELS.**  
Hydrocomp, Inc., Palo Alto, Calif.  
D. Franz.  
Available from the National Technical Information Service as PB-232 987: \$6.00 in paper copy, \*1.45 in microfiche. Completion Report, April 1974. 53 p, 7 tab, 11 ref. OWRRC-C-3266(3736)(1).

Descriptors: \*Dew point, \*Solar radiation, \*Wind speed, Meteorology, Humidity, Energy balance, Regression analysis, \*Air temperature, Simulation analysis, Model studies, Operations research, United States, \*Forecasting, Water temperature.

Predictive relationships for mean daily dew point temperature, daily total shortwave solar radiation, and daily wind movement using daily maximum and minimum air temperature as the predictor variable were derived for approximately 23 stations in the United States. A simple linear regression of dew point on minimum temperature proved to be best for the dew point prediction. The fit was best in the humid regions in the winter and poorest in the summer in the arid and semi-arid regions. Percent of possible solar radiation was regressed on the daily range in temperature for the solar radiation relationship. The fit obtained was poorer than the fit for dew point. The coefficient of correlation for the dew point relationships was most frequently in the range of 0.7 to 0.95 while for solar radiation the range was generally for 0.5 to 0.8. The standard error of estimate for dew point ranged from 2.0 to 10.0 degrees Fahrenheit with most values in a narrower range from 4.0 to 6.0 degrees. The standard error for solar radiation was most frequently in the range of 10 to 25 percent.  
W74-08933

**LABORATORY SIMULATION OF RAINFALL EROSION FOR GULLY FORMATION STUDY.**  
Kentucky Univ., Lexington. Water Resources Research Inst.  
For primary bibliographic entry see Field 2J.  
W74-08937

**ACID RAIN: A SERIOUS REGIONAL ENVIRONMENTAL PROBLEM.**  
Cornell Univ., Ithaca, N.Y. Section of Ecology and Systematics.  
For primary bibliographic entry see Field 5B.  
W74-09098

**REFINEMENT OF THE PRECIPITATION AMOUNT AS APPLIED TO CALCULATION OF**

## Field 2—WATER CYCLE

### Group 2B—Precipitation

**WATER BALANCE OF LAKE BAYKAL, (UTOCHNENIYE VELICHINY OSADKOV PRIMENTEL'NO K RASCHETU VODNOGO BALANSA OZ. BAYKAL),** Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
For primary bibliographic entry see Field 2H. W74-09102

**THE POSSIBILITIES OF THE IDENTIFICATION OF PRECIPITATION ZONES WITH MISZ (METEOROLOGICAL ARTIFICIAL EARTH SATELLITES),** A. G. Gorelik, V. V. Kalashnikov, and Yu. A. Frolov.  
Available from NTIS, Springfield, Va. 22151, as AD-766 035 Price \$3.00 printed copy; \$1.45 microfiche. Air Force Foreign Technology Division Translation Report FTD-MT-24-699-73, August 1973. 14 p. 4 fig. 2 tab. 11 ref. (Translated from Trudy Tsentral'noy Aerologicheskoy Observatorii. Sputnikovaya Meteorologiya, No 103, p 31-41, 1972.)

Descriptors: \*Remote sensing, \*Satellites(Artificial), \*Precipitation(Atmospheric), Solar radiation, Surveys, Synoptic analysis, Data collections.

Precipitation zones may be sensed from the earth and from meteorological artificial Earth satellites with the aid of passive radar equipment. Radio brightness contrasts of the different types of clouds are determined by the form of the underlying surface against the background of which radiometric measurements are conducted. For all wavelengths the contrasts are increased with an increase in the reflection coefficient of the underlying surface. (Knapp-USGS)  
W74-09196

### 2C. Snow, Ice, and Frost

**EFFECTS OF ICE FORMATION ON THE SALT REGIME OF A RESERVOIR (VLIYANIYE LEDOBRAZOVANIYA NA SOLEVOY REZHIM VODOKHRANILISHCHA),** Vsesoyuznyi Nauchno-Issledovatel'skii Institut Vodosnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenerno Gidrogeologii, Moscow (USSR).  
V. A. Baranov, and I. A. Bystrov.  
Vodnyye Resursy, No 4, p 188-192, 1973. 1 fig. 4 tab. 6 ref.

Descriptors: \*Ice, \*Reservoirs, \*Water chemistry, \*Salt balance, \*Salts, Ions, Chemical precipitation, Water balance.  
Identifiers: \*Ukrains, \*USSR(Donets Basin), Mineralization.

During ice formation, precipitation of salts from water of reservoirs in the Donets Basin in the Eastern Ukraine occurs in direct proportion to thickness of ice cover. For the Staro-Krymskoye Reservoir, the quantity of salts precipitated in 1958-65 during periods of complete ice cover was 2%-5% of their total content in the reservoir. To forecast dissolved-salts content of reservoir water, special laboratory experiments are needed to study precipitation of salts during formation of ice. (Josefson-USGS)  
W74-08704

**THE RELEASE OF WATER FROM FOREST SNOWPACKS DURING WINTER,** Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.  
H. F. Haupt.  
USDA Forest Service Research Paper INT-114, January 1972. 17 p. 7 fig. 4 tab. 9 ref.

Descriptors: \*Snowpacks, \*Canopy, \*Lysimeter, \*Throughfall, \*Forests, Snowfall, Evaporation,

Snowmelt, Water level recorders, Rainfall, Precipitation(Atmospheric), Ablation, Interception, Solar radiation, \*Rocky Mountain Region, Topography, Water equivalent, Winter.

Data collected on releases of water in undisturbed forests and small openings on two slope aspects over a three-year period are analyzed. The problem of measuring the outflows from beneath a snowpack directly was solved by the designing of a snow lysimeter. Results of the study showed that mature forest cover and topographic exposure greatly influence the release of snow water to the soil mantle. More water is usually available to recharge the soil mantle in small openings than in forested areas. Through fall-drip from the forest canopy is the major contributor to water release in the forest, and is directly dependent on the interception and detention of snow in the canopy. The volume of outflow from snowpacks is greater beneath the canopy than from small openings. The main difference originates from the intercepted snow by the canopy which is converted to drip which in turn percolates through the snowpack. (Mastic-Arizona)  
W74-08761

**ICE THRUST ON SHORES OF NORTH GERMAN LAKES AND ITS EFFECT,** K. Laskar, and K. Strenze.  
Available from NTIS, Springfield, Va. 22151 as AD-769 728, price \$3.00 printed copy; \$1.45 microfiche. Army Cold Regions Research and Engineering Laboratory Draft Translation 405, August 1973. 7 p. 7 fig. Translated from Natur und Volk (Nature and Man), No 71, p 63-70, 1941.

Descriptors: \*Lakes, \*Ice cover, \*Iced lakes, \*Beaches, Geomorphology, Beach erosion, Scour, Ice loads, Ice jams.  
Identifiers: \*Ice thrust, Ice pressure, \*Germany(Ploner Lake).

Beach ridges may be formed by ice pressure as the result of temperature variations and subsequent volume changes of the ice cover, or by ice thrusting due to wind action. The latter type predominates in Germany. A specific minimum basin area is a prerequisite for large-scale thrust action. Several cases of ice thrust on the Ploner Lake (Germany) are described. The ice blocks pile up parallel over each other along the shore and push inland. (Knapp-USGS)  
W74-09219

**EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES,** National Environmental Satellite Service, Hillcrest Heights, Md.  
D. R. Wiesnet, D. F. McGinnis, and M. Matson.  
Available from NTIS, Springfield, Va. 22151 as N73-29220 - Price \$3.50 printed copy; \$1.45 microfiche. Status and Technical Progress Report, July 1973. 6 fig. 3 tab. 7 ref.

Descriptors: \*Ice, \*Snow cover, \*Mapping, \*Remote sensing, Great Lakes, Aerial photography, Snowmelt, Ice cover, Iced lakes.  
Identifiers: \*ERTS.

Mapping of snow cover using ERTS-1 data was six times faster than using U-2 photography. Ice conditions in the Great Lakes can readily be determined by ERTS-1. Ice features characteristic of thawing conditions such as rotten ice, lack of pressure ridges, brash belts and compacted ice edges can be identified. A great decrease in apparent reflectivity in band 7 as compared to band 4 also indicates melting conditions. Using sidelap from two successive ERTS-1 images of Lake Erie (February 17 and 18, 1973) a measure of ice movement was made, agreeing closely with the estimate from conventional methods. The same imagery permitted tentative identification of the following features: shuga, light and dark nilas, fast ice, icefoot, ice breccia, brash ice, fracturing, ridging, rafting, sas-

trugi, thaw holes, rotten ice, ice islands, dried ice puddles, humnocked ice, and leads. (Knapp-USGS)  
W74-09230

### 2D. Evaporation and Transpiration

**CONTROLLED ENVIRONMENT STUDIES OF THE EFFECTS OF VARIABLE ATMOSPHERIC WATER STRESS ON PHOTOSYNTHESIS, TRANSPIRATION, AND WATER STATUS OF ZEA MAYS L. AND OTHER SPECIES,** Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.  
H. D. Barrs.  
In: Plant Response to Climatic Factors UNESCO, 1973, p 249-258, 6 fig. 1 tab. 24 ref.

Descriptors: \*Photosynthesis, \*Transpiration, \*Greenhouses, \*Moisture stress, \*Corn(Field), Flow resistance, Flow rates, Leaves, Carbon dioxide, Relative humidity, Temperature, Stomata, Root systems, Rhizosphere.  
Identifiers: Ohm's law, Water potential.

The movement of water through some selected plant species was investigated. This study contradicted the assumption that resistance to flow of water from the roots through the stems to evaporation sites in the leaves is constant, which is analogous to an Ohm's law type of relationship. Studies conducted on a maize plant showed that resistance declined progressively as the transpiration rate increased in response to a lowered relative humidity and a constant temperature. There was considerable variation in behavior among species and no overall pattern analogous to an Ohm's law relationship was exhibited. A feature common to all species studied was a decline in resistance to flow as flow rate increased, although the importance and extent varied among species. Also the net photosynthetic rate was not reduced as relative humidity was lowered for all species. (Mastic-Arizona)  
W74-08754

**COTTON LEAF TEMPERATURES AS RELATED TO SOIL WATER DEPLETION AND METEOROLOGICAL FACTORS,** Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
For primary bibliographic entry see Field 3F. W74-08755

**AIR TEMPERATURE AND VAPOR PRESSURE CHANGES CAUSED BY SPINKLER IRRIGATION,** Agricultural Research Service, Kimberly, Idaho. Snake River Conservation Research Center.  
For primary bibliographic entry see Field 3F. W74-08757

**MEASUREMENT OF EVAPOTRANSPIRATION IN THE PRESENCE OF ADVECTION, BY MEANS OF A MODIFIED ENERGY BALANCE PROCEDURE,** Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.  
A. R. G. Lang.  
Agricultural Meteorology, Vol 12, p 75-81, 1973. 3 tab. 15 ref.

Descriptors: \*Evapotranspiration, \*Advection, \*Energy equation, \*Heat flow, \*Energy gradients, Wind velocity, Temperature, Humidity, Height.  
Identifiers: Bowen ratio, Energy balance, Horizontal gradients, Vertical gradients, Philip's theory.

Large errors in evapotranspiration measures can be caused by local advection. These errors can be

## Streamflow and Runoff—Group 2E

calculated by an energy balance equation solved in terms of the Bowen ratio measured at a single height above the surface. This analysis was consistent with previous data confirming that a single height for measuring horizontal gradients of temperature and humidity can be used to obtain reliable data on evapotranspiration. Reliable measurements of evapotranspiration in the presence of large advective fluxes can be made using energy balance methods at a height of about 1 meter according to the described procedures. Further research is necessary to determine the general usefulness of the procedures, particularly for estimating horizontal gradients using a single height for measurements. (Mastic-Arizona)  
W74-08760

**PLANT WATER STATUS IN RELATION TO CLOUDS,**  
Georgia Coastal Plain Experiment Station, Tifton. J. R. Stansell, B. Klepper, V. D. Browning, and H. M. Taylor.  
Agronomy Journal, Vol 65, No 4, p 677-678, July-August, 1973. 2 fig, 2 ref.

Descriptors: \*Evapotranspiration, \*Soil moisture, Plant tissues, Cloud cover, \*Clouds.

Clouds can cause significant changes in plant water status in a short time. Therefore, care should be taken to sample different treatments under comparable radiation. (Skogerboe-Colorado State)  
W74-08801

**PREDICTION OF DEW POINT TEMPERATURE, SOLAR RADIATION AND WIND MOVEMENT DATA FOR SIMULATION AND OPERATIONS RESEARCH MODELS,**  
Hydrocomp, Inc., Palo Alto, Calif.  
For primary bibliographic entry see Field 2B.  
W74-08933

**DIGITAL-COMPUTER PROGRAMS FOR ANALYSIS OF GROUND-WATER FLOW,**  
Geological Survey, Little Rock, Ark.  
For primary bibliographic entry see Field 2F.  
W74-09115

**A SENSITIVITY AND ERROR ANALYSIS OF PROCEDURES USED FOR ESTIMATING EVAPORATION,**  
Maryland Univ., College Park. Dept. of Civil Engineering.  
R. H. McCuen.  
Water Resources Bulletin, Vol 10, No 3, p 486-497, June 1974. 3 tab, 11 ref.

Descriptors: \*Evaporation, Mathematical studies, Equations, Meteorology, Variability, Heat transfer, Heat budget, Winds, Model studies.  
Identifiers: \*Error analysis, \*Sensitivity analysis.

The structure of commonly used evaporation models, the effect of variation in meteorological factors on observed evaporation rates, and the effect of error in measurements of the meteorological factors were studied by sensitivity and error analyses. Error in evaporation estimates resulting from measurement error in meteorological factors in probably much less than 5% of the computed evaporation rate. The importance of the different meteorological factors varies in time and space. The sensitivity analysis indicates that the Fractional-Evaporation Equivalent method is structurally inadequate and the Weather Bureau model is more flexible than the Penman model. However, the Penman model provides more realistic estimates of the importance of the various meteorological factors. (Knapp-USGS)  
W74-09201

**WATER LOSS FROM AN IRRIGATED SORGHUM FIELD: II. EVAPOTRANSPIRATION AND ROOT EXTRACTION,**  
South Dakota State Univ., Brookings. Dept. of Plant Science.  
For primary bibliographic entry see Field 3F.  
W74-09249

## 2E. Streamflow and Runoff

**DETERMINATION OF GEOMETRIC AND HYDRAULIC CHARACTERISTICS OF A STREAM CHANNEL BY SOLUTION OF INVERSE PROBLEMS FOR SAINT VENANT EQUATIONS (OPREDELENIE GEOMETRICHESKIKH I GIDRAVLICHESKIKH KHAARAKTERISTIK RECHNOGO RUSLA PUTEM RESHENIYA OBRATNYKH ZADACH DLYA URAVNIY SEN-VENANA),**  
Gidrometeorologicheskii Nauchno-Issledovatel'skii Tsentr, Leningrad (USSR).  
V. I. Koren', and L. S. Kuchment.  
Vodnyye Resursy, No 4, p 83-100, 1973. 6 fig, 2 tab, 15 ref.

Descriptors: \*Hydraulics, \*Channels, \*Channel flow, \*Channel morphology, Roughness (Hydraulic), Mannings equation, Discharge (Water), Floods, Water levels, Optimization.  
Identifiers: \*USSR, \*Saint Venant equations.

Saint Venant equations are the most thoroughly studied model of unsteady channel flow and are widely used to calculate movement of flood waves and reservoir releases. Determining geometric and hydraulic characteristics of a stream channel is based on observations of the water regime. Solution of this problem is unstable, and additional information is needed on properties of the solution and on possible errors in initial data. Algorithms are proposed for solving the problem at varying amounts of initial data, using the theory of incorrect problems and optimization procedures. Algorithms proposed were tested on the basis of data of special observations conducted on the Svir' River in northeastern Leningrad Oblast and on the Tvertsa River in Kalinin Oblast. (Josefson-USGS)  
W74-08707

**NUMERICAL COMPUTATION OF MOMENTUM JETS AND FORCED PLUMES,**  
Battelle-Pacific Northwest Labs., Richland, Wash.  
For primary bibliographic entry see Field 8B.  
W74-08782

**A COMPARATIVE ESTIMATE OF ENERGY LOSSES IN WATER BODIES AND IN TRANQUIL AND TURBULENT FLOWS (SRAVNITEL'NAYA OTSENKA POTER' ENERGIY V VODOYEMAKH, SPOKOYNYKH I BURNYKH POTOKAKH),**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
For primary bibliographic entry see Field 2H.  
W74-09109

**WATER RESOURCES DATA FOR GEORGIA, 1973,**  
Geological Survey, Doraville, Ga.  
For primary bibliographic entry see Field 7C.  
W74-09116

**AN INVESTIGATION OF SECONDARY FLOW EFFECTS IN CURVED CHANNELS OF SQUARE CROSS SECTION,**  
Naval Postgraduate School, Monterey, Calif.  
For primary bibliographic entry see Field 8B.  
W74-09193

**SURFACE WATER TEMPERATURES AT SHORE STATIONS, UNITED STATES WEST COAST, 1972,**

Scripps Institution of Oceanography, La Jolla, Calif.  
Available from NTIS, Springfield, Va. 22151 as AD-768 375 Price \$2.75 printed copy; \$1.45 microfiche. Data Report (SIO Reference 73-15), May 1973. 20 p, 1 fig. ONR Contract N00014-69-A-0200-6006.

Descriptors: \*Water temperature, \*Salinity, \*Sea water, \*Pacific Ocean, Data collections, Hydrologic data, Oceanography, Sampling.

Temperature and salinity data observed during 1972 at shoreline stations along the west coast of North America from the Strait of Juan de Fuca, Washington, to La Jolla, California, are compiled. The data consist of monthly means, ranges, and standard deviations based on daily observations. Temperature readings and water samples are obtained from surf and sandy beaches, off rocky cliffs and ledges, over the sides of lightships, and off piers, depending upon the station location. (Knapp-USGS)  
W74-09197

**SMALL-STREAM FLOOD INVESTIGATIONS IN ALASKA, A COMPILATION OF PEAK DATA, MAY 1963 TO SEPTEMBER 1972,**  
Geological Survey, Anchorage, Alaska.  
S. H. Jones.  
Basic-data report, 1973. 55 p, 8 fig, 3 tab, 5 ref.

Descriptors: \*Peak discharges, \*Small watersheds, \*Alaska, Stage-discharge relations, Floods, Stream gages, Data collections, Hydrologic data.

A small-stream flood investigation program for Alaska was initiated in September 1962. This program was designed to provide flood data on streams with drainage areas generally less than 100 square miles, placing particular emphasis on those with areas of less than 50 square miles. The objective was to obtain sufficient flood data to define the magnitude and frequency of floods on a regional basis for the entire State and provide information for detailed hydrologic studies. Hydrologic data obtained under this program consist primarily of the annual maximum instantaneous stages and discharges. (Knapp-USGS)  
W74-09218

**THE PINE-POPPLE RIVER BASIN--HYDROLOGY OF A WILD RIVER AREA, NORTHEASTERN WISCONSIN,**  
Geological Survey, Washington, D.C.  
E. Oakes, S. J. Field, and L. P. Seeger.  
Available from Sup Doc, GPO, Washington, D.C. 20402. Price \$3.20 (paper cover). Water Supply Paper 2006, 1973. 57 p, 16 fig, 2 plate, 7 tab, 26 ref.

Descriptors: \*Wild rivers, \*Wisconsin, Water resources, Water utilization, Recreation, Fishing, Boating, Water supply, Water quality, Data collections, Hydrologic data.  
Identifiers: \*Pine-Popple river basin (Wisc).

The Pine and Popple Rivers, virtually unaltered by man, flow through a semiprimitive area of forests, lakes, and glacial hills in Wisconsin. White-water streams, natural lakes, fish and animal life, and abundant vegetation contribute to the unique recreational and aesthetic characteristics of the area. The basin covers about 563 square miles in northeastern Wisconsin. Swamps and wetlands cover nearly 110 square miles, and the 70 lakes cover about 11 square miles. The undulating topography is formed by glacial deposits overlying an irregular, resistant surface of bedrock. An annual average of 30 inches of precipitation, highest from late spring to early autumn, falls on the basin. Of this amount, evapotranspiration, highest in mid summer and later summer, averages 19 inches; the

## Field 2—WATER CYCLE

### Group 2E—Streamflow and Runoff

remaining 11 inches is runoff, which is highest in spring and early summer. Groundwater from the glacial drift is the source of water for the minor withdrawal use in the basin. The major uses of water are for recreation and power generation. No water is withdrawn from lakes or streams, and no sewage or industrial wastes are added to lakes or streams. Most of the flow of the Pine River is used for power generation. The main stems of the Pine and Popple Rivers contain 114 canoeable miles, of which 95% is without such major obstructions as falls or large rapids. In general, streams support cold-water fish, and lakes support warm-water fish. The basin has no significant water problems. (Knapp-USGS)  
W74-09223

### 2F. Groundwater

**ESTIMATION AND MAPPING OF RATES OF EXCHANGE OF FRESH GROUNDWATER IN THE BALTIC ARTESIAN BASIN (OTSSENKA I KARTIROVANIYE TEMPOV VODOOBMENNA PRESNYKH PODZEMNYKH VOD (NA PRIMERE PRIBALTIYSKOGO ARTEZIAN-SKOGO BASSEYNA)).**  
Akademiya Nauk SSSR, Moscow. Institut Vodnykh Problem.  
I. S. Zektser, and L. B. Koval'skiy.  
Vodnyye Resursy, No 4, p 113-123, 1973. 3 fig, 17 ref.

Descriptors: Groundwater, \*Groundwater basins, \*Artesian aquifers, \*Estimating, \*Mapping, Groundwater recharge, Groundwater movement, Base flow, Subsurface flow, Hydrogeology.  
Identifiers: \*USSR (Baltic Sea region), \*Water exchange, Isolines.

The Baltic artesian basin, which covers about 214,000 sq km in the USSR, includes Estonia, Latvia, Lithuania, the Kaliningrad Oblast, and northern regions of Belorussia. The southwestern part of the basin is located in Poland. Possibilities of estimating and mapping rates of exchange of fresh groundwater were based on data on subsurface flow. Periods of water exchange within the Sventoji-Tartu aquifer complex range from 250 years to 10,000 years, depending upon specific natural conditions of the region. A comparative estimate was made of different methods of determination of rates of water exchange and of their applicability. (Josefson-USGS)  
W74-08705

**GROUNDWATER RECHARGE FROM A PORTION OF THE SANTA CATALINA MOUNTAINS,**  
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.  
R. A. Belan, and W. G. Matlock.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proc. of the 1973 meetings of the Arizona Section-AWRA and the Hydrology Section-Arizona Academy of Science, May 4-5, 1973, Tucson, Arizona, p 33-40, 1973. 3 fig, 1 tab, 11 ref.

Descriptors: \*Aquifers, \*Groundwater recharge, \*Groundwater basins, \*Geohydrologic units, Groundwater, Infiltration, Precipitation (Atmospheric), Surface runoff, Geology, Faults (Geologic), Arroyos, Joints (Geologic), Alluvial fans, Well data, Hydraulic gradient, Flow nets, Water quality, Transmissivity, Darcy's Law, \*Watersheds (Basins), Mountains, \*Arizona.

The geohydrology of a portion of the Santa Catalina Mountains including the definition of aquifer systems in the foothills was studied in order to calculate groundwater recharge to the Tucson Basin. This underlying groundwater aquifer is the only source of Tucson, Arizona's water supply. A well network, well logs, geologic profiles, and a water level contour map were used

as source information. Recharge was found to occur in some sections of washes and close to the mountains where washes cross or coincide with faults. Significant recharge to sand and gravel aquifers occurs directly through faults and joints. Little of the surface runoff is thought to recharge local aquifers because of low permeability layers beneath the alluvium and the short duration of the flows. Recharge calculation using the Darcy equation was subject to considerable error; but flow net analysis showed the total recharge to be 336 acre-feet per year representing about 50 acre feet per mile of mountain front per year. (Mastic-Arizona)  
W74-08764

**THE EFFECT OF DATA DENSITY ON GROUNDWATER CONTOURING ACCURACY,**  
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.  
P. R. Davis, and W. G. Matlock.  
Transactions of the ASAE (American Society of Agricultural Engineers), Vol 16, No 6, p 1112-1116, November-December, 1973. 7 fig, 1 tab, 3 ref.

Descriptors: Investigations, \*Groundwater basins, \*Contours, \*Mapping, \*California, \*Data collections.

The effect of different data densities on contour maps representing fairly uniform data was investigated. Tests were conducted in California on a groundwater basin of 780 sq miles. The Standard Map for the basin was drawn from 445 randomly located data points which covered an interior area of 411 sq miles. Spacings between input points of 1, 4, and 6 miles were analyzed with three tests each on the 4 and 6 mile spacings. Tests were also made on a 6 mile triangular grid and a semirandom grid obtained by dividing the area into squares 6 miles on a side and then randomly selecting a grid intersection within each square. The number of tests conducted was insufficient to draw any conclusions, but the tests support the belief that the more observations there are, the more accurately the surface will be defined. For investigations where detailed groundwater contour maps are not required, a data density with approximately 4 miles between points is suggested. Additional data points may be added near the fringes if extended control is necessary. (Merritt-FIRL)  
W74-08781

**NORTHERN ILLINOIS USES STORAGE EFFECTIVELY,**  
For primary bibliographic entry see Field 4B.  
W74-08909

**FLOW TOWARD PERIODIC TITLE DRAINS,**  
Wisconsin Univ., Milwaukee. School of Architecture.  
I. Gyuk, A. Soriano, and G. M. Karadi.  
Journal of Hydrology, Vol 19, No 2, p 113-129, June, 1973. 9 fig, 3 ref. OWRR A-029-WIS(3).

Descriptors: \*Drainage, \*Groundwater, \*Tile drainage, Subsurface drainage, Drainage practices, Drainage systems, Soil water movement, Drainage engineering, Mapping, Flow.  
Identifiers: Conformal mapping.

The method of conformal mapping is applied to the analysis of transient flow toward parallel periodic drains in a semi-infinite aquifer taking into consideration the non-linear boundary conditions on the free surface. The mapping function is expressed as a power series in time and the seepage domain is mapped onto a domain of an auxiliary complex variable. Mapping is performed in such a manner that the free surface will always remain the real axis. Calculations are carried out for different ratios of drain depth to drain spacing using various drain diameter to depth ratios. (Skogerboe-Colorado State)  
W74-08923

### UNSTEADY FLOW TO BOTTOM DRAIN IN BOUNDED AQUIFER,

Northwestern Univ., Evanston, Ill. Technological Inst.  
R. J. Krizek, A. Soriano, and I. Gyuk.  
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 99, No 1R2, p 169-182, June, 1973. 6 fig, 11 ref.

Descriptors: \*Groundwater, \*Aquifers, \*Aquifer characteristics, Drainage, Tile drains, Irrigation, Seepage, Transition flow, \*Unsteady flow, Mapping.  
Identifiers: Conformal mapping, Complex variables.

The problem of transient seepage toward a drain at the bottom of a homogeneous, isotropic aquifer is presented. The dependent variables are the position of the free surface, the flow rate, and the pore pressure distribution around the drain, and these are determined as functions of time for various depths of drainage and drain sizes; the characteristics of the aquifer are specified in terms of its coefficient of permeability and its effective porosity. The mathematical statement of this problem yields to a time-dependent potential field within a strip domain by the impervious bottom, the moving free surface, and a small semicircular contour representing the drain. To overcome the difficulty of a moving boundary, a conformal mapping technique is used to transform the problem into a new plane in which the free surface remains straight and fixed. The solution of the problem is found to the third order of time, and an upper bound is given to limit the range within which it is valid. (Skogerboe-Colorado State)  
W74-08926

### GEOTHERMICS.

Available from Maxwell Scientific International, Inc. Fairview Park, Elmsford, NY 10523, Price \$60.00 (2 vol). Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 975-1725, 1973.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Conferences, Hydrogeology, Groundwater, Thermal power, Economics, Brines, Mineralogy.  
Identifiers: \*Geothermal power.

The geothermal resources of the world were discussed at a symposium held at Pisa in 1970. The specific topics discussed include hydrogeology, economics, exploration, borehole geophysics, powerplant design, hydraulics, byproduct heat and chemicals, and powerplants operation. The conference proceedings contain about 200 individual papers. (See W74-08974 thru W74-09048) (Knapp-USGS)  
W74-08973

### GEOTHERMAL POTENTIAL OF IDAHO,

Idaho Bureau of Mines and Geology, Moscow.  
S. H. Ross.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 975-1008, 1973. 13 fig, 2 tab, 68 ref.

Descriptors: \*Thermal water, \*Geothermal studies, \*Idaho, Thermal springs, Hot springs, Hydrothermal studies, Mineral water, Thermal power.  
Identifiers: \*Geothermal power.

The first comprehensive inventory and evaluation of thermal groundwater in the State of Idaho since 1925 shows that such water can be expected in wells and springs almost anywhere along the margins of the Snake River Plain or in valleys south of the Plain. In addition, about one-half of the ap-

proximately 200 thermal springs in the state emerge from granitic rocks or silicic volcanic rocks along the borders of the Idaho batholith. Although no stream has been observed, water in a few wells is boiling, and temperatures of many springs are only slightly lower. Sodium and bicarbonate are the dominate ions in most waters, although a few highly mineralized springs are the sodium-chloride type. Specific electrical conductance of thermal waters from granitic rocks averages between 300 and 400 micromhos/cm at 25 deg C; average conductivity of thermal water from volcanic rocks is somewhat higher. Much of the water usually high in silica and fluoride, even though concentrations of other minerals are low. (See also W74-08973) (Knapp-USGS)  
W74-08974

**GEOTHERMAL PROSPECTS IN NEW MEXICO,**  
New Mexico Bureau of Mines and Mineral Resources, Socorro.  
W. K. Summers.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1009-1014, 1973. 3 fig, 2 tab, 6 ref.

Descriptors: \*Thermal water, \*Geothermal studies, \*New Mexico, Thermal springs, Hot springs, Hydrothermal studies, Mineral water, Thermal power.  
Identifiers: \*Geothermal power.

Fifty-seven areas in New Mexico discharge groundwater at a temperature of 90 deg F or higher. Thermal waters occur in the western half of the state, primarily in the Rio Grande and Gila-San Francisco drainage basins. Only 16 areas have been discovered by wells, whereas 30 areas are marked by springs. The water issues from rocks ranging from Precambrian to Cenozoic age with the Cenozoic rocks predominating. The waters are associated with igneous and sedimentary rocks in about equal proportions. The water occurs primarily in areas of extensive volcanism and secondarily in fault zones. The water discharges from springs near streams but mostly at points well above the river levels. The discharge may be from fractures directly from beneath a talus cover, from alluvium, or from some combinations of these. (One spring discharges from a tufa mound). The median pH is 7.7, the median maximum temperatures is about 105 deg F, the median discharge of springs is 30.5 gpm, and the median concentration of sodium is 167 ppm, of magnesium 6.9 ppm, of calcium 37.6, of lithium 0.30 ppm, and of potassium 10.0 ppm. The most promising prospects for natural stream in New Mexico are the Animas Valley in Hidalgo County, the Cliff-Gila-Riverside area in Grant County, the southern Rio Grande trough, and the Upper Jemez River Basin. (See also W74-08973) (Knapp-USGS)  
W74-08975

**GEOTHERMAL RESOURCES OF GUATEMALA, CENTRAL AMERICA,**  
Instituto Nacional de Electrificación (Guatemala).  
R. Fernandez-Rivas.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1015-1025, 1973. 5 fig, 4 tab, 34 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Guatemala.

Guatemala offers possibilities for the exploitation of geothermal energy as there are some thermal evidences near Amatitlan Lake, Zunil, Aguas Amargas, and Aguas Georginas. A map shows the thermal regions of Amatitlan. A list of the prin-

cipal known volcanoes is given. (See also W74-08973) (Knapp-USGS)  
W74-08976

**GEOTHERMAL RESOURCES OF COSTA RICA.**  
Servicio Nacional de Electricidad, San Jose (Costa Rica).

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1026-1029, 1973. 2 tab.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Costa Rica.

A short description of the development of electric energy in Costa Rica is given. Numerous areas exhibit geothermal manifestations, but studies conducted in this field are scanty. These areas are generally associated with Quaternary volcanic systems. The most promising springs are found in Las Hornillas on the southern side of the Miravalles volcano, and Las Pailas on the southern side of the Rincon de la Vieja volcano. (See also W74-08973) (Knapp-USGS)  
W74-08977

**THERMAL AND MINERAL SPRINGS IN UGANDA,**  
Uganda Geological Survey and Mines Dept., Entebbe.  
C. G. Dixon, and W. H. Morton.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1035-1038, 1973. 3 tab, 8 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Uganda.

The geothermal power potential in Uganda and the thermal springs are described. The temperatures of the springs vary from quite cool to boiling. The salinity of the mineral springs of Uganda varies greatly from one to another, both as regards the quantity and the chemical composition of the dissolved solids. The salinity of individual springs is known to have changed in the course of time. For instance, the water of Kibiro had 5.98 grams of dissolved solids per liter in the year 1920, 10.92 in 1921, and 22.28 in 1935. Most of the thermal and mineral springs of Uganda are in or near the Western Rift Valley and its associated volcanic centers, while five are in the eastern part of the country not far from the Eastern Rift Valley of Kenya. During 1954 three boreholes were drilled at Durance in order to investigate the possibility of locating supplies of geothermal steam. In No. 1 borehole the highest temperature recorded was 58 deg C at the main rift fault zone, which was penetrated at a depth of 564-579 feet. In No. 2 borehole the highest temperature was 55 deg C, and drilling was stopped at 1,294 feet after the main fault zone had been penetrated. In No. 3 borehole, which was located 150 feet west of No. 1, the highest temperature recorded was 72 deg C. (See also W74-08973) (Knapp-USGS)  
W74-08978

**GEOTHERMAL RESOURCES IN TANZANIA,**  
Tanzania Mineral Resources Div., Dodoma.  
M. A. Nzaro.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1039-1043, 1973. 1 fig, 1 tab, 10 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Tanzania.

Thermal springs are numerous in Tanzania but their distribution and local concentration is uneven. The main areas of spring activity are in the neighborhood of the rift valleys and block faulted regions associated with the rift systems. In other areas, springs are related to local rock formations such as limestones, quartzites, lavas and sandstones. The existence of thermal springs indicates the presence of geothermal energy. Suitable structures are very likely to occur in Tanzania, in areas where karoo or more recent sediments overlie the basement rocks, and in the vicinity of the springs in the Tertiary volcanic provinces. (See also W74-08973) (Knapp-USGS)  
W74-08979

**GEOTHERMAL RESOURCES IN INDIA,**  
Central Water and Power Commission, New Delhi (India).

B. R. R. Iyengar.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1044-1049, 1973. 3 fig, 2 tab, 19 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*India.

Geothermal fields were discovered at several places in India. Neither systematic nor exhaustive studies of these fields have so far been carried out, except for the provision of limited tourist and bathing facilities at the spring sites. No direct relationship has as yet been established between igneous activity and the occurrence of thermal springs. On the basis of limited information, it would appear that the geothermal resources in India are mostly in the form of hot water, with the near-surface temperatures varying from about 80 deg C to just over 100 deg C. Higher flows, temperatures, and pressures are likely to be obtained by drilling at suitable sites in the Puga and Manikaran geothermal fields. The observed temperature of water in the well at Cambay was about 100 deg C. There are indications that temperatures of the order of 170 deg C may exist at depth in this field. It has been estimated that the maximum amount of power generation would be available by flashing down the water. The maximum generation possible at this point is about 1850 to 2300 kW, based on the estimated flow of each well. On the basis of similar studies, the possible power generation at Manikaran would be in the order of 350 kW and, in the case of Puga Valley springs, about 400 kW. (See also W74-08973) (Knapp-USGS)  
W74-08980

**A PROGRAM FOR THE EXPLORATION OF HIGH TEMPERATURE AREAS IN ICELAND,**  
National Engineering Authority, Reykjavik (Iceland).  
S. Bjornsson.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1050-1054, 1973. 4 fig, 1 tab.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power, \*Iceland.

In regional geothermal surveys in Iceland, all relevant methods of geology, geochemistry and geophysics are applied to obtain a primary model

## Field 2—WATER CYCLE

### Group 2F—Groundwater

of the hydrothermal system and to locate favorable production sites within the area. After a production site is selected, exploratory drilling is carried out. The objective of the drilling is to verify and modify the primary model of the hydrothermal system. It will also furnish critical information for designing production wells and evaluating whether exploitation of the area will be technically possible and economically feasible. If the results of this phase are promising, production drilling and testing will be carried out in several steps to test the production capacity and the reliability of the thermal area. Regional surveys are estimated to take 1-3 years, exploratory drilling at each production site 1-2 years, and production drilling and testing 1-3 years. (See also W74-08973) (Knapp-USGS)  
W74-08981

#### GEOTHERMAL AREAS OF CZECHOSLOVAKIA.

Geindustria, Prague (Czechoslovakia).  
S. Klir.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1055-1058, 1973. 2 fig, 3 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Czechoslovakia.

The main thermal areas in Czechoslovakia are confined to the Krusne Hory graben in the Bohemian Massif and to a fault system along the River Vah in the West Carpathians. The location, geological situation, and thermal capacity of the springs at the localities of Carlsbad, Sokolov, Teplice, Piestany, Sklenne Teplice, and Banska Stiavnica are described in addition to the methods of using thermal energy. (See also W74-08973) (Knapp-USGS)  
W74-08982

#### GEOTHERMAL EXPLORATION OF HOT WATER SOURCES IN THE CARPATHIANS OF YUGOSLAVIA AND CZECHOSLOVAKIA.

Scintrex Ltd., Concord (Ontario).

B. Krcmar, and B. Milanovic.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1059-1062, 1973. 8 fig.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power, \*Yugoslavia, \*Czechoslovakia.

There are many hot water sources in the Carpathian system in both Czechoslovak and Yugoslav territories. Temperature measurements are accomplished with the use of the Czechoslovak geothermometer GT-1, which enables sensitive gradient measurements in shallow boreholes at the depth of approx. 0.9 and 1.4 meters. Many of the sources are of small capacity, with temperatures under 70 deg C, but due to suitable mineralization they are appropriate for balneological purposes. Results from Yugoslav localities Vranjska Banja and Sijarinska Banja give some hope of economic potential for power exploitation. (See also W74-08973) (Knapp-USGS)  
W74-08983

#### THERMAL FIELDS OF THE EASTERN CARPATHIANS.

Akademiya Nauk URSR, Kiev. Institut Geofiziki.  
R. I. Kutas, and V. V. Gordiyenko.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1063-1066, 1973. 2 fig, 1 tab, 6 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*USSR(Carpathians region).

Heat flow was studied in 43 boreholes within the southwestern slope of the Russian Platform and in the folded Carpathians of the USSR. Four tectonic zones with different geological records have been distinguished in terms of heat flow values: the slope of the Russian Platform and a part of the Carpathian foredeep with the Pre-Cambrian basement—1.05 micro/sq cm/sec; the northern part of the Lvov and Carpathian foredeep with the Paleozoic basement—1.30 micro/sq cm/sec; folded Carpathians—1.75 micro/sq cm/sec; Trans-Carpathian trough—2.15 micro/sq cm/sec. Heat flow depends on the geological age of a given area and does not agree with crustal thickness. The zones of abnormally high heat flow result from the effect of nonstationary heat sources occurring near the crustal bottom. The period of activity of the heat sources shows good agreement with the period of folding in the Carpathians as deduced from the geological evidence. (See also W74-08973) (Knapp-USGS)  
W74-08984

#### DEVELOPMENT OF RESEARCH AND UTILIZATION OF GEOTHERMAL RESOURCES IN THE USSR.

Scientific Council on Geothermal Studies, Moscow (USSR).

A. N. Tikhonov, and I. M. Dvorov.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1072-1078, 1973. 1 tab.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power, \*USSR.

Reserves of thermal waters over the range of temperatures from 50 deg to 200 deg C have been tentatively estimated in USSR as being over 8 million cu m per day. Geothermal resources in USSR are being utilized for the purpose of heating, for hot water supply of living and industrial buildings, for heating hotbeds and greenhouses, for growing vegetables, and for cattle-breeding needs, in extracting chemical matter from geothermal waters, for balneology and for electric power generation. (See also W74-08973) (Knapp-USGS)  
W74-08985

#### GEOTHERMAL RESOURCES OF THE USSR AND PROSPECTS FOR THEIR PRACTICAL USE.

Akademiya Nauk SSSR, Moscow. Geologicheskii Institut.

F. A. Markarenko, B. F. Mavritsky, B. A. Lokshin, and V. I. Kononov.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1086-1091, 1973. 1 fig, 1 tab, 6 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power, \*Iceland.

Studies of the principles governing the area extent of thermal waters over USSR territory, and estimates of their heat potential, mineralization, and composition, delineate ten territories for possible utilization. Among them are the platform regions where thermal waters are stratified and folded areas, where fissure-vein type hot waters are found. Within these promising regions possible reserves have been estimated for thermal waters with a mineralization not exceeding 35 g/liter, a temperature above 40 deg C, and at a depth not exceeding 3,000 m. These reserves are over 250 cu m per sec. (See also W74-08973) (Knapp-USGS)  
W74-08986

#### THERMAL WATERS OF GEORGIA.

Gruzinskii Politehnicheskii Institut, Tiflis (USSR).

I. M. Buachidse, G. I. Buachidse, and M. P. Shaorshadze.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1092-1101, 1973. 2 fig, 1 tab, 10 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*USSR(Georgia).

Thermal waters have been known in Georgia, USSR, since ancient times. Various types of thermal waters are found in Georgia from fresh hydrocarbonate calcium to highly mineralized chloride. In gas composition, nitrogen prevails though carbon dioxide and hydrocarbons are found. Thermal waters discharge in three places in the folded system of the Great Caucasian southern slope, are widely developed on the Georgian block and in the folded system of the Adjara-Trialeti, and are also found at some points in the Artvin-Somkhiti block. The Georgian block is the richest in thermal waters. The main thermal horizon is in lower-Cretaceous deposits, which, for the most part, contain low mineralized infiltrated waters of modern age, atmospheric nitrogen, temperatures reaching 105 deg C, and a total debit of 650 liter/sec. In the Adjara-Trialeti folded system, the most important waters are those of the Middle-Eocene deposits, which are typical of the nitrogen thermal waters of modern age with temperatures of 70 deg - 80 deg C and a total output of 210 liter/sec. Thermal waters of Georgia are used (and in the future will be used more widely) at the balneologic resorts, in greenhouse economy, in the processing industry, and for the local heating systems of small and medium populated areas. (See also W74-08973) (Knapp-USGS)  
W74-08987

#### RECENT HYDROTHERMAL SYSTEMS OF KAMCHATKA.

Institut Vulkanologii, Petropavlovsk-Kamchatskii (USSR).

E. A. Vakin, B. G. Polak, V. M. Sugrovov, E. N. Erlikh, and V. I. Belousov.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1116-1133, 1973. 11 fig, 4 tab, 25 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*USSR(Kamchatka).

Recent hydrothermal activity was studied in Uzon-Semyachik, Pauzhetka-Kambalny and other regions in Kamchatka. In the area of recent volcanism characterized by a general increase of conductive heat flow, some regions can be distinguished by an especially intense geothermal regime with additional supply of heat by deep

fluids. Recent hydrothermal systems of Kamchatka are small artesian basins and artesian slopes. They are associated with volcano-tectonic grabens and circular depressions filled with a series of tuffaceous material of mainly acid composition. Usual hydrodynamic methods can be used for a quantitative estimation of reserves. Hydrothermal activity is one of the manifestations of the general geothermal activity of the region. (See also W74-08973) (Knapp-USGS)  
W74-08989

**GEOLOGY AND GEOTHERMAL POWER POTENTIAL OF THE TATUN VOLCANIC REGION,**  
Mining Research and Service Organization, Taipei (Taiwan).  
C. H. Chen.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1134-1143, 1973. 5 fig, 1 tab, 13 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Taiwan(Tatun volcanic region), Republic of China.

Geothermal resources in the Tatun volcanic region of Taiwan occur in an area of about 350 sq km containing Plio-Pleistocene andesitic and basaltic lavas, pyroclastics, and detritus. Most of the andesitic lavas in the region are compact and impermeable. Unless highly fractured they cannot be good reservoir rock. The basement is composed of Miocene sediments of marine and continental facies. The Lower Miocene Wuchihshan formation consists mainly of thick-bedded to massive sandstone that could be good reservoir rock. There are 13 hot-spring areas in the volcanic region, which constitute a zone about 18 km long and 3 km wide, extending from Peitou to Chinsan. Most of the hot springs issue acid sulphate-chloride water. Acid chloride water with temperatures lower than 200°C and pH values less than 4 was found in the Wuchihshan sandstone under the Tahuangtsui thermal area. Wet steam containing about 25% of water (maximum temperature > 240 deg C, pH = 3.9 to 6.7) was found in fractured andesites under the Matsao thermal area. The power potential of the whole hot-spring zone is conservatively estimated to be 80 MW to 200 MW. (See also W74-08973) (Knapp-USGS)  
W74-08990

**RECENT PLANS OF GEOTHERMAL EXPLOITATION,**  
Japan Metals and Chemicals Co. Ltd., Morioka. Geothermal Power Div.  
Y. Mori.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1144-1149, 1973. 4 fig, 2 tab.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Japan.

Prospecting in Japan is being carried out in order to build two more geothermal powerplants besides the one of 20,000 kW now in operation. The exploitable area seems to be wider than first expected, and the Kakkonda River area is more advantageous in natural resources than Matsukawa. Kakkonda is located 7 km southwest of Matsukawa. Here, the steaming ground stretches as far as a 3 x 5 km area without any caprock. Cooling water is also abundant, and the amount is ten times as much as that of Matsukawa. Chemical quality of the steam is excellent with pH 7-8 compared with 5 in the case of Matsukawa. The power in

prospect at Kakkonda is approximately 200,000 kW while that of Matsukawa amounts to only 100,000 kW. The topography is not as steep as in Matsukawa. (See also W74-08973) (Knapp-USGS)  
W74-08991

**EXPLOITATION OF THE MATSUKAWA GEOTHERMAL AREA,**  
Japan Metals and Chemicals Co. Ltd., Morioka. Geothermal Power Div.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, p 1150-1156, 1973. 6 fig, 4 tab.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power, \*Japan(Matsukawa).

In Matsukawa, Japan, the local government of the village began in 1952 the experimental development of hot springs for health purposes. In this process steam blew out (instead of hot water) from a depth of 150-300 meters. In 1960, two wells 350 and 425 meters deep were experimentally drilled. The temperature in those bores changed seasonally, partly because of the low temperature of the underground water near the land surface. New wells for steam production should be as deep as 1200 meters. Construction of a 5,000 kW electric plant was planned. In 1964 the construction work started. In 1965 the first plan for 5,000 kW was changed to 20,000 kW. The discharge of No 1 well decreased, and one more well had to be added. At present, steady full load operation is 20,000 kW. The power capacity in the Matsukawa area is estimated to be approximately 100,000 kW; investigations are being continued. See also W74-08973) (Knapp-USGS)  
W74-08992

**THE GEOTHERMAL SYSTEM OF THE KAKONE VOLCANO,**  
Hot Spring Research Inst. of Kanagawa Prefecture, Hakone (Japan).  
Y. Oki, and T. Hirano.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Japan(Hakone Volcano).

The isothermal map of the Hakone volcano, Japan, at sea level shows that the geothermal area now 12 by 13 km in diameter is clearly related to the present volcanic activity. Four zones are recognized in the distribution of thermal waters. Zone I is characterized by acid-sulfate water associated with solfataric gases, and is found at the highest elevation of the volcano. Zone II is characterized by bicarbonate-sulfate water issuing at the middle elevation. Zone III has high-temperature streams rich in sodium chloride, poor in bicarbonate and sulfate, flowing from the depth of active fumaroles across the zone of bicarbonate-sulfate water (zone II). Zone IV is characterized by sodium chloride-bicarbonate-sulfate water discharged at the lowest elevation. Groundwater which infiltrates through the western side of the caldera seems to be flowing eastward, passing through the basal part of central cones where high-temperature dense steam is coming up through volcanic vents. Subsurface streams of high-temperature waters thus start from the vent area, run through the permeable zone mixing with groundwater, and appear as hot springs on the steep slopes of the Hayakawa gorge at the east. The average contribution of volcanic dense steam rich in sodium chloride is estimated to be 25 to 35% to the sodium chloride water of zone III. Thermal

discharge evaluated by the geochemistry of sodium chloride water is 21 to 30 million cal/sec, which suggests that the energy economy of the Hakone geothermal system is essentially controlled by the activity of dense steam carrying a considerable amount of sodium chloride. (See also W74-08973) (Knapp-USGS)  
W74-08993

**TYPES OF COMMERCIAL DEPOSITS OF THERMAL UNDERGROUND WATERS AND SOME VIEWS ON THE ASSESSMENT OF THEIR RESERVES,**

Vsesoyuznyi Nauchno-Issledovatel'skii Institut Gidrogeologii i Inzhenernoi Geologii, Moscow (USSR).  
N. M. Frolov, and G. S. Vartanian.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1167-1174, 1973. 4 fig, 17 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power.

All known ground thermal water occurrences of the world may be grouped into the following main types, based on geological and hydrodynamic conditions: thermal water occurrences of large artesian basins of platform areas; thermal water occurrences of small artesian basins of intermontane areas and submontane troughs of alpine zones of folding; and thermal water occurrences of crystalline massifs connected with fissure-vein systems of recent tectonic disturbances. Large artesian thermal water occurrences occur usually at a great depth and are notable for a high salinity. Among the thermal water occurrences of alpine type, thermal water occurrences confined to the areas of late and recent volcanism are of the greatest industrial interest. (See also W74-08973) (Knapp-USGS)  
W74-08994

**THERMAL STUDIES AS A TECHNIQUE IN SUBSURFACE STRUCTURAL INVESTIGATIONS,**

Akademiya Nauk Azerbaidzhanskoi SSR, Baku. Inst. of Problems of Deep Oil and Gas Deposits.  
S. T. Ovnanatov, and G. P. Tamrazyan.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1184-1190, 1973. 4 fig.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power.

Thermal studies can be used to reveal the peculiarities of the geological structure of oil- and gas-bearing regions. The studies conducted make it possible to get valuable information concerning the subsurface structure. These studies help to find buried uplifts. On the basis of thermal studies the subsurface occurrence (under marine conditions) of a gas-mud volcano was predicted. The drilling conducted later confirmed the presence of the volcano. Forecasting of the buried mud volcanoes is used to locate the occurrence of oil- and gas-bearing suites at depth. Also, the study of thermal subsurface fields helps to determine the conditions of distribution of oil and gas reservoirs, which is of practical importance in field prospecting and development. (See also W74-08973) (Knapp-USGS)  
W74-08995

## Field 2—WATER CYCLE

### Group 2F—Groundwater

#### GEOHYDROLOGY OF THE LAUGARNES HYDROTHERMAL SYSTEM IN REYKJAVIK, ICELAND

National Energy Authority, Reykjavik (Iceland). T. Thorsteinsson, and J. Eliasson.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1191-1204, 1973. 11 fig, 4 tab, 8 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power, \*Iceland.

A geohydrologic survey was made in 1965 in the Laugarnes hydrothermal system in Reykjavik, Iceland. The survey was conducted by recording gages and by periodic measurements of water levels in nonpumping wells. A mathematical analysis of the relation between water levels and pumping rates and of the response of the water level to changes in atmospheric pressure, oceanic tides, and earthquakes shows the effects of volume elasticity of the Laugarnes aquifers and their water. The test data gave values ranging from 0.0035 to 0.0088 for the coefficient of transmissivity and 0.000039 to 0.00032 for the coefficient of storage. The aquifers appear to be impermeably bounded on two sides, the boundaries intersecting at an angle of 60 to 90 degrees. A decline of water level of 66.8 meters was computed for the period January 1957 to August 1969, and a further decline of 6.2 meters for the 5-year period August 1969 to August 1974, assuming 1968 to 1969 pumping rates. (See also W74-08973) (Knapp-USGS)  
W74-08996

#### GEOHERMAL FIELDS IN JAPAN CONSIDERED FROM THE GEOLOGICAL AND PETROLOGICAL VIEW POINT

Hokkaido Univ., Sapporo (Japan). Dept. of Geology and Mineralogy.  
T. Ishikawa.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1205-1211, 1973. 3 fig, 16 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Japan.

Heat sources of most geothermal fields in Japan are related to young volcanoes or pre-Quaternary intrusives. Acidic magmas are more significant for generation of geothermal areas than basic ones. In Japan, geothermal areas nearly always develop around lava domes built of dacite and andesite. Lava domes plug crater vents and prevent gas and heat accumulated at depth from escaping into the air. (See also W74-08973) (Knapp-USGS)  
W74-08997

#### CONTINENTAL DRIFT AND THERMAL FIELDS

Akademiya Nauk Azerbaidzhanskoi SSR, Baku. Institut Geologii.  
G. P. Tamrazyan.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1212-1225, 1973. 9 fig, 15 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*USSR, \*Continental drift.

The separation of platform regions during continental drift results in large depressions in which the more intensively heated deep-seated masses approach the earth surface. Major thermal anomalies originate in these areas. All the most important high-temperature regions of the USSR (the West-Siberian, Turan, Caspian lowlands, the pre-Caucasus, the Kuban lowland, the Crimea Steppe, and other regions) are situated just between the separated edges of the West-Siberian ruptured joint and in its branchings. The continental drift ideas are of paractical importance with regard to prospecting for the interior heat of the earth, as they outline vast areas characterized by sharply intensified heat fields. (See also W74-08973) (Knapp-USGS)  
W74-08998

#### GEOHERMAL RESOURCES AND PRESENT OROGENIC ACTIVITY

Stuttgart Univ. (West Germany). Geologisch-Palaeontologisches Institut.  
H. G. Wunderlich.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1226-1230, 1973. 8 fig.

Descriptors: \*Geothermal studies, \*Thermal water, \*Orogeny, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*Orogeny.

Some zones of abnormally high heat flow show a characteristic position relative to young orogenic belts. Usually, orogenic fronts are combined with low heat flow values in the foreland and high heat flow behind the front. Geothermal resources of economic interest may be expected where volcanic activity, heat conductivity of the crust, and orogenic heat concentration are working together. Young orogenic fronts are distinguished by strong negative gravity anomalies shifted outward in the foreland direction. The inner girdle of such active orogens is marked by volcanoes, by large volumes of granitic material (if enclosed in the continental crust), and by regional metamorphism as an indication of intensified heat flow. Present orogenically intensified heat flow behind the active orogenic fronts is shown by a series of maps. (See also W74-08973) (Knapp-USGS)  
W74-08999

#### GEOPHYSICAL EXPLORATION THROUGH GEOLOGIC COVER

D. W. Strangway.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1231-1243, 1973. 16 fig, 37 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power.

Some of the techniques that can be applied to the problem of geophysical exploration beneath various kinds of cover and overburden are discussed. The electrical properties found in different geographic environments and the problems of exploring in areas of high resistivity and low resistivity cover are reviewed. Induced polarization, electromagnetic sounding, magnetotellurics and radio frequency interferometry have a particular application in areas of high resistivity cover. The problem of exploring in areas of low resistivity cover is much more difficult. The induced polarization technique can be used in these cases, but it requires a better understanding of the problems of electromagnetic coupling. New

techniques of data processing and filtering can help significantly in the problem of aeromagnetic interpretation in areas of volcanic cover. (See also W74-8973) (Knapp-USGS)  
W74-09000

#### GEOHERMAL PROSPECTING IN SHALLOW HOLES AND ITS LIMITATIONS

Institute of Applied Geophysics, Prague (Czechoslovakia).  
D. Dedkova, J. Halousek, B. Krcmar, and K. Prihoda.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1244-1249, 1973. 4 fig, 8 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power.

Difficulty of temperature measurement in boreholes considerably limits the sensitivity depth of geothermal investigations. From the point of view of the attainable accuracy and reproducibility, error sources, both instrumental and in the temperature field itself, are analyzed. The design of a Czechoslovak geothermometer GT-1 with reproducibility better than 0.04 deg C is comprehensively described. Some possibilities of improvements in geothermal prospecting in shallow holes, such as the gradient method, standard points method, and long-term variation corrections, are outlined. Some examples of hydrogeological, sulfidic ores, and speleological investigations are given. (See also W74-08973) (Knapp-USGS)  
W74-09001

#### ORIGIN OF GEOTHERMAL WATERS OR NATURAL STEAM

Mineral Research and Exploration Inst., Ankara (Turkey).  
S. Kavlakoglu.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1250-1255, 1973. 12 fig, 17 ref.

Descriptors: \*Geothermal studies, \*Thermal water, Thermal springs, Hot springs, Hydrothermal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power.

For the generation of geothermal water or natural steam, a reservoir of meteoric water, a heat source, and a mass of dynamic meteoric water circulating through natural permeable channels to the heat source and back to the meteoric water reservoir through a different permeable channel are required. A discussion is given for two cases; one for the case of heated meteoric water, the other for heated meteoric water mixed with juvenile water from the heat source. Using Darcy's law with the theoretical treatment of invasion, it is shown that the heated water from the heat source would invade the static reservoir along a wide based cylindrical zone in both cases. Verification of this theoretical finding was demonstrated through geophysical and drilling results at the Gecik-Afyon and Saraykoy-Denizli geothermal areas in Turkey and the Broadlands geothermal area in New Zealand. (See also W74-08973) (Knapp-USGS)  
W74-09002

#### EVALUATION OF OPERATIONAL RESERVES OF HIGH TEMPERATURE WATERS

Institut Vulkanologii, Petropavlovsk-Kamchatskii (USSR).  
V. M. Sugrovov.

## WATER CYCLE—Field 2

### Groundwater—Group 2F

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1256-1260, 1973. 3 fig, 2 tab, 6 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data. Identifiers: \*Geothermal power, USSR.

Resources of geothermal steam in the USSR are at present evaluated on the basis of the discharge of steam-water mixture. Evaluation of exploitable resources of thermal waters for a certain period of exploitation of a deposit may be done by definition of the decline of piezometric level according to the unsteady filtration formula. Continuous exploitation of the systems is maintained by outflow of heat, which is located in the heated rocks, and by the inflow of the geothermal deep-seated steam to the zone of depression with intensive outflow of the mass and heat from the upper horizons. (See also W74-08973) (Knapp-USGS) W74-09003

**TERRESTRIAL HEAT FLOW IN THE TERRITORY OF CZECHOSLOVAKIA AND THE MEASUREMENT OF THERMAL CONDUCTIVITY WITH FULLY-AUTOMATIC APPARATUS,** Československá Akademie Ved, Prague. Geofyzikální Ústav. For primary bibliographic entry see Field 4B. W74-09004

**HEAT AND MASS TRANSFER IN HYDROTHERMAL SYSTEMS, PHYSICAL-MATHEMATICAL MODELS AND EXPERIMENTS,** Institut Geokhimii, Irkutsk (USSR). V. N. Kochergin, and V. D. Pampura. In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1266-1269, 1973. 3 fig, 2 ref.

Descriptors: \*Heat transfer, \*Mass transfer, \*Hydrothermal studies, \*Geothermal studies, Convection, Mathematical models, Hydraulic models, Heat flow, Thermal conductivity, Hydraulic conductivity. Identifiers: USSR.

In order to investigate processes of heat and mass transfer as well as the dynamics of the formation of temperature fields of natural hydrothermal systems, physico-mathematical models were developed which accounted for conditions of contemporary hydrothermal processes (temperature, pressure, thermo-physical properties, of rocks, and latent heats of transitions). The mathematical model consists of a system of partial differential equations for a two-layer medium (liquid and solid) with an immobile boundary between solid and liquid phases. Models of this type were performed on an IBM computer. Physical models were carried out by means of a hydrothermal experiment at elevated temperatures (up to 200 deg C) and pressures. (See also W74-08973) (Knapp-USGS) W74-09005

**STUDY OF HEAT CONDUCTION MODELS OF GEOTHERMAL ENERGY RESERVOIRS,** Mining Research and Service Organization, Taipei (Taiwan). C. Y. Meng, and P. T. Shaw.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1270-1274, 1973. 9 fig, 3 ref.

Descriptors: \*Heat transfer, \*Mass transfer, \*Hydrothermal studies, \*Geothermal studies, Convection, Mathematical models, Hydraulic models, Heat flow, Thermal conductivity, Hydraulic conductivity. Identifiers: USSR.

Temperature anomalies in a rock formation are direct evidence of the existence of geothermal reservoirs. Prospecting for geothermal energy by measurement of the temperature gradient in the rock formation overlying a geothermal reservoir could, theoretically, be effective. Thermal conduction models of different presumed geothermal reservoir shapes are discussed. A geothermal reservoir is considered to be a constant hot body overlain by physically uniform rock formations. Temperature distribution in the overlying rock formation may be represented by the surfaces of constant temperature whose shapes are closely related to the shape of the hot body. The shape of temperature curves at equal depth in a vertical cross-section reflects also the depth, shape, and size of the geothermal energy reservoir. The differences in material and inflow of groundwater in the overlying formation would seriously affect the temperature distribution, the shape of the constant temperature surfaces, and the shape of the temperature curve for the equal depths, consequently making them differ from the models. (See also W74-08973) (Knapp-USGS) W74-09006

**ENDOCRAVE, A NEW DEVICE FOR THE STUDY OF HEAT AND MASS TRANSFER BY SIMULATION OF GEOLOGICAL BODIES AND PROCESSES UNDER DYNAMIC CONDITIONS,** Akademiya Nauk SSSR, Novosibirsk. Institut Geologii i Geofiziki. A. N. Dudarev.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1275-1279, 1973. 2 fig, 2 tab.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Laboratory equipment, Heat flow, Mass transfer, Hydraulic models, Autoclaves. Identifiers: \*Endoclaves.

For simulating geodynamic processes, a thermo-gradient endocrave permits simultaneous wide-range investigations of petrophysical thermodynamics in simulated systems. Rock volumes may be up to 2 cu m. During the experiment all the surface of the rock block is open and accessible for measurements. It is possible to generate radial and vertical gradient fields of temperatures inside the sample from 0 to 150-200 deg C/cm, both dry and wet. (See also W74-08973) (Knapp-USGS) W74-09007

**HEAT TRANSFER MEASUREMENT IN THE OWAKUDANI AND SOUNZAN GEOTHERMAL AREAS, HAKONE VOLCANO,** National Research Center for Disaster Prevention, Tokyo (Japan). K. Yuhara.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1280-1288, 1973. 9 fig, 6 tab, 8 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Heat transfer, \*Heat flow, Volcanoes, Stream, Sampling, Thermal water, Thermal springs, Data collections, Borehole geophysics, Mass transfer, Thermal conductivity. Identifiers: \*Geothermal power, \*Japan.

In geothermal areas, heat is transferred by various processes, such as fumaroles, steam wells, hot springs, steaming grounds, evaporation from hot pools and thermal conduction through the earth.

As a practical example, heat transfer measurements in the Owakudani and Souzan geothermal areas of Hakone volcano, Japan, are outlined. Total mass discharge from these areas amounts to 129 kg/sec and total heat transfer amounts to 10.24 million cal/sec. In Japan where there are about twenty geothermal areas, each having the same size as the Owakudani and Souzan areas put together, the thermal discharge from all these areas may be estimated roughly to be  $2 \times 10^{10}$  to the 23rd power erg/year. In addition to this, the energy released by volcanic activity is  $7 \times 10^{10}$  to the 23rd power erg/year, by common hot springs,  $1.1 \times 10^{10}$  to the 24th power erg/year, and by the normal heat flow of nonvolcanic regions,  $7.3 \times 10^{10}$  to the 24th power erg/year. The total energy released from the whole of Japan, except that by earthquakes, is about  $9 \times 10^{10}$  to the 24th power erg/year. (See also W74-08973) (Knapp-USGS) W74-09008

**AN ESTIMATE OF THE NATURAL HEAT RESOURCES IN A THERMAL AREA IN ICELAND,**

Oregon State Univ., Corvallis. Dept. of Oceanography. G. Bodvarsson.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1289-1293, 1973. 1 fig, 10 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data. Identifiers: \*Geothermal power, \*Iceland.

Various geological and geophysical principles involved in the exploitation of geothermal areas are summarized for the Hengill high-temperature thermal area located 30 to 40 km east of the city of Reykjavik, Iceland. The rate at which stored heat can be tapped depends on the availability of water. An estimate of the order of magnitude of the total recoverable heat resources in the Hengill area, based on a reservoir model, indicates that a total of the order of 10,000 million metric tons of water at 220 to 230 deg C could be produced in this area during a period of 100 years. This water is flashed in the boreholes and will yield a total of 250 million tons of dry saturated steam with a pressure ranging from 10 to 2 atmospheres. The estimated production rate of steam is of the order of 3000 tons/hour, or comparable to the production which has already been obtained in the geothermal area at Larderello in Tuscany, Italy. The production costs, based on the rate of 300 tons/hour of steam, are estimated at \$ 0.16/ton steam, and the investment necessary is estimated at \$5,000.00/ton steam/hour. Corresponding figures for larger installations would probably be somewhat lower. (See also W74-08973) (Knapp-USGS) W74-09009

**GROUND SUBSIDENCE OF A GEOTHERMAL FIELD DURING EXPLOITATION,**

Ministry of Works, Wairakei (New Zealand). For primary bibliographic entry see Field 4B. W74-09010

**EFFECT OF EARTH STRAIN ON GEYSER ACTIVITY,** Colorado Univ., Boulder. Dept. of Mechanical Engineering. J. S. Rinehart.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1297-1301, 1973. 8 fig, 9 ref.

## Field 2—WATER CYCLE

### Group 2F—Groundwater

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geysers, \*Earthquakes, Strain, Movement, Thermal water, Stress.  
Identifiers: \*Yellowstone National Park, \*Earth strain.

The very extensive and detailed records that have been kept for the past three decades on the activity of Old Faithful Geyser, located in Yellowstone National Park, make it possible to establish causative relationships between earth strain and geyser activity. A 2- or 3- year steady decrease in average interval between eruptions can precede a large earthquake. This is followed at the time of the earthquake by a sudden lengthening of interval which continues for about fifteen days. Local earthquakes of intensity V or greater can be presaged and accompanied by a gradual and regular decrease in interval over a time span of a few days, followed by an abrupt increase. Such a pattern of change is not always accompanied by an earthquake; this probably indicates non-catastrophic release of strain. While the effects of varying earth strains are recognizable, they do not appear to be a major factor in controlling the efflux of geothermal energy. (See also W74-08973) (Knapp-USGS)  
W74-09011

**PHOTOGRAMMETRIC TECHNIQUES APPLIED IN THE DEVELOPMENT OF GEOTHERMAL RESOURCES IN MATSUKAWA AND OTAKE GEOTHERMAL AREAS USING A VECTOR METHOD.**  
International Geodetic Survey Inst. Co. Ltd., Tokyo (Japan).  
For primary bibliographic entry see Field 4B.  
W74-09012

**CHEMISTRY IN THE EXPLORATION AND EXPLOITATION OF HYDROTHERMAL SYSTEMS.**  
Department of Scientific and Industrial Research, Wellington (New Zealand). Chemistry Div.  
For primary bibliographic entry see Field 2K.  
W74-09013

**STATIC INTERPRETATION OF CHEMICAL RESULTS FROM DRILLHOLES AS AN AID TO GEOTHERMAL PROSPECTING AND EXPLOITATION.**  
Department of Scientific and Industrial Research, Wellington (New Zealand).  
For primary bibliographic entry see Field 4B.  
W74-09014

**ORIGIN OF THERMAL WATERS ON THE BASIS OF THEIR RADIOISOTOPIC CONTENT.**  
Adademiya Nauk SSSR, Moscow. Geologicheskii Institut.  
For primary bibliographic entry see Field 2K.  
W74-09015

**THE COLLECTION AND ANALYSIS OF VOLCANIC AND HYDROTHERMAL GASES.**  
Department of Scientific and Industrial Research, Taupo (New Zealand). Chemistry Div.  
For primary bibliographic entry see Field 2K.  
W74-09016

**INTERPRETATION OF GAS COMPOSITIONS FROM THE WAIRAKEI FIELD OVER 10 YEARS.**  
Department of Scientific and Industrial Research, Taupo (New Zealand). Chemistry Div.  
For primary bibliographic entry see Field 2K.  
W74-09017

**HIGH ACTIVITY HYDROTHERMAL ZONES DETECTED BY NA/K, CERRO PRIETO, MEXICO.**  
Comision Federal de Electricidad, Mexico City. Geothermochemical Research.  
For primary bibliographic entry see Field 2K.  
W74-09018

**CHEMICAL STUDIES IN MEXICAN GEOTHERMAL FIELDS.**  
Comision Federal de Electricidad, Mexico City. Inst. of Investigations of Electrical Industry.  
For primary bibliographic entry see Field 2K.  
W74-09019

**GEOCHEMISTRY OF THE AHUACHAPAN THERMAL AREA, EL SALVADOR, CENTRAL AMERICA.**  
Iceland Univ., Reykjavik. Science Inst.  
For primary bibliographic entry see Field 2K.  
W74-09020

**A NOTE ON THE HOT SPRINGS OF ECUADOR.**  
Proyecto Minero, Quito (Ecuador).  
For primary bibliographic entry see Field 2K.  
W74-09021

**DEUTERIUM AND CHLORIDE IN GEOTHERMAL STUDIES IN ICELAND.**  
Iceland Univ., Reykjavik. Science Inst.  
For primary bibliographic entry see Field 2K.  
W74-09022

**CHEMICAL PROSPECTING OF STEAM AND HOT WATER IN THE MATSUKAWA GEOTHERMAL AREA.**  
Japan Metals and Chemicals Co., Ltd., Morioka.  
For primary bibliographic entry see Field 2K.  
W74-09023

**GEOCHEMISTRY OF THE WATERS DISCHARGED FROM DRILLHOLES IN THE OTAKE AND HATCHOBARU AREAS.**  
Kyushu Univ., Beppu (Japan). Inst. of Balneotherapeutic Research I.  
For primary bibliographic entry see Field 2K.  
W74-09024

**THE BEHAVIOUR OF THE WAIRAKEI GEOTHERMAL FIELD DURING EXPLOITATION.**  
Ministry of Works, Wellington (New Zealand).  
For primary bibliographic entry see Field 4B.  
W74-09025

**A STUDY OF THE RESERVOIR AT THE MATSUKAWA GEOTHERMAL FIELD.**  
Geological Survey of Japan, Kawasaki.  
For primary bibliographic entry see Field 4B.  
W74-09026

**SOME GEOTHERMAL MEASUREMENTS AT THE OTAKE GEOTHERMAL AREA.**  
Kyushu Univ., Fukuoka (Japan). Research Inst. of Industrial Science.  
M. Fukuda, K. Ushijima, K. Aosaki, and N. Yamamuro.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1448-1457, 1973. 15 fig, 6 tab, 4 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data.  
Identifiers: \*Geothermal power, \*Japan (Otake).

Thermal discharge, temperature gradient and thermal conductivity of rock samples were measured at Otake geothermal area, Japan. The heat flow from the strong fumaroles was measured by condensing the natural steam. The heat flow from the weak fumaroles was measured by using a wet and dry bulb thermometer. The underground temperature gradient is 1.9 deg C/m in steaming ground and 0.8 deg C/m in other geothermal areas. The thermal conductivity of 30 dried core samples was measured in the laboratory and in situ by means of the line source methods. The range is 0.000773 to about 0.0172 cal/sec cm C. The thermal conductivity of unaltered rocks is greater than that of altered ones. (See also W74-08973) (Knapp-USGS)  
W74-09027

**ESTIMATION OF HYDROTHERMAL SYSTEMS BY MEANS OF WELL-HEAD OBSERVATIONS.**  
National Research Center for Disaster Prevention, Tokyo (Japan).  
For primary bibliographic entry see Field 4B.  
W74-09028

**GEOTHERMAL DRILLING AND PRELIMINARY TEST OPERATIONS AT KIZILDERE, TURKEY.**  
Mineral Research and Exploration Inst., Ankara (Turkey). Technical data.  
For primary bibliographic entry see Field 8A.  
W74-09029

**PRESENT STATE OF DRILLING AND REPAIRING OF GEOTHERMAL PRODUCTION WELLS IN JAPAN.**  
Teiseki Sakusei Kogyo Co. Ltd. (Japan).  
For primary bibliographic entry see Field 8A.  
W74-09030

**GEOTHERMAL DRILLING IN THE MATSUKAWA AREA.**  
Japan Metals and Chemicals Co. Ltd., Morioka.  
For primary bibliographic entry see Field 8A.  
W74-09031

**CASING STRING DESIGN FOR GEOTHERMAL WELLS.**  
Ministry of Works, Wellington (New Zealand).  
For primary bibliographic entry see Field 8A.  
W74-09032

**EFFECT OF SLOTTED LINEAR CASING IN GEOTHERMAL BORES.**  
Japan Metals and Chemicals Co. Ltd., Morioka. Geothermal Power Div.  
For primary bibliographic entry see Field 8A.  
W74-09033

**FACTORS CONTROLLING BOREHOLE PERFORMANCE.**  
Department of Scientific and Industrial Research, Taupo (New Zealand).  
R. James.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1502-1515, 1973. 10 fig, 10 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Water yield, \*Thermodynamics, Hydrogeology, Discharge (Water), Drawdown, Steam, Hydrodynamics, Boreholes.  
Identifiers: \*Well efficiency, \*Geothermal power, \*Well performance.

Geothermal boreholes were studied to estimate maximum discharges when drawing on (a) a source of pressurized hot water, (b) a source of dry or superheated steam. Where infinite permeability existing at depth (which is common in areas similar

to that at Wairakei, New Zealand), only geometry of the hole controls the flow rate. Also investigated was the effect on discharge of increased hole size throughout the depth or over fractions of the depth, with resultant flow increases quantitatively established. The relationships derived enable fall in borefield discharge to be predicted for known decline in temperature and pressure within the reservoir. The enthalpy may be accurately determined by a method using the maximum running pressure, the wellhead pressure at which imminent collapse of the stream-water mixture occurs, and the bottom hole pressure. A critical discharge pressure tapping located at the pipe outlet face may then measure flow rates direct over a range of wellhead pressures and hence supply the data required to plot the borehole characteristic curve. The conditions were also considered where rock permeability controls the flow into the bottom of boreholes either from radial fissures or from permeable-porous media. (See also W74-08973) (Knapp-USGS)  
W74-09034

**CURRENT STATUS OF GEOTHERMAL POWER PLANTS AT THE GEYSERS, SONOMA COUNTY, CALIFORNIA,**  
Pacific Gas and Electric Co., San Francisco, Calif. Dept. of Engineering.  
For primary bibliographic entry see Field 4B.  
W74-09035

**PHYSICO-CHEMICAL SAMPLING OF HIGH TEMPERATURE WELLS IN CONNECTION WITH THEIR ENCRUSTATION BY CALCIUM CARBONATE,**  
Akademiya Nauk SSSR, Novosibirsk. Institut Neorganicheskoi Khimii.  
For primary bibliographic entry see Field 4B.  
W74-09036

**PRODUCTION OF FRESH WATER FROM THE ENDOGENOUS STEAM OF CERRO PRIETO GEOTHERMAL FIELD,**  
Comision Federal de Electricidad, Mexico City.  
For primary bibliographic entry see Field 3A.  
W74-09037

**THERMAL WATERS AS A SOURCE FOR EXTRACTION OF CHEMICALS,**  
Akademiya Nauk SSSR, Moscow. Geologicheskii Institut.  
For primary bibliographic entry see Field 2K.  
W74-09038

**EXPLORATION OF THE REYKIANES THERMAL BRINE AREA,**  
National Energy Authority, Reykjavik (Iceland).  
For primary bibliographic entry see Field 2K.  
W74-09039

**CONTRIBUTION TO THE MINERAL EXTRACTION FROM SUPERSATURATED GEOTHERMAL BRINES, SALTON SEA AREA, CALIFORNIA,**  
For primary bibliographic entry see Field 2K.  
W74-09040

**GEOTHERMAL PRODUCTION OF ELECTRICAL ENERGY AND CERTAIN MINERALS,**  
Makerere Univ., Kampala (Uganda). Dept. of Physics.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1656-1657, 1973. 3 tab.

Descriptors: \*Hydrothermal studies, \*Mineral water, Hot springs, Thermal springs, Geothermal water, Thermal power, Brines, Water chemistry.

Identifiers: \*Geothermal power, \*Uganda.

Geothermal manifestations in Uganda are listed. Their exploitation could be of great interest both from an energy point of view and for minerals. There are probably over 20 centers of hot water springs in Uganda and most of them are located in the western arm of the East African Rift valley around the Ruwenzori range of mountains. (See also W74-08973) (Knapp-USGS)  
W74-09041

**GEOTHERMAL ENERGY RESOURCES FOR HEATING AND ASSOCIATED APPLICATIONS IN ROTORUA AND SURROUNDING AREAS,**  
Ministry of Works, Rotorua (New Zealand).  
For primary bibliographic entry see Field 4B.  
W74-09042

**SOME METHODS OF DEALING WITH LOW ENTHALPY WATER IN THE ROTORUA AREA OF NEW ZEALAND,**  
Cooke (W. L.) Ltd, Auckland (New Zealand).  
For primary bibliographic entry see Field 4B.  
W74-09043

**TECHNICAL-ECONOMIC ESTIMATION OF GEOTHERMAL RESOURCES,**  
Akademiya Nauk URSR, Kiev. Inst. of Technical Thermophysics.  
For primary bibliographic entry see Field 6B.  
W74-09044

**THE ECONOMICS OF THE SMALL GEOTHERMAL POWER STATION,**  
Department of Scientific and Industrial Research, Wairakei (New Zealand). Chemistry Div.  
For primary bibliographic entry see Field 6C.  
W74-09045

**ECONOMICS OF THE GEYSERS GEOTHERMAL FIELD, CALIFORNIA,**  
Thermal Power Co., San Francisco, Calif.  
For primary bibliographic entry see Field 6C.  
W74-09046

**ECONOMICS OF GEOTHERMAL ELECTRIC POWER GENERATION AT MATSUKAWA,**  
Japan Metals and Chemicals Co. Ltd., Tokyo. Exploitation Dept.  
For primary bibliographic entry see Field 6C.  
W74-09047

**WAIRAKEI POWER STATION NEW ZEALAND—ECONOMIC FACTORS OF DEVELOPMENT AND OPERATION,**  
Ministry of Works, Wellington (New Zealand).  
For primary bibliographic entry see Field 6C.  
W74-09048

**NEUTRON WELL LOGGING IN HAWAII,**  
Hawaii Univ., Honolulu. Water Resources Research Center.  
For primary bibliographic entry see Field 4B.  
W74-09053

**SOME ASPECTS OF APPROXIMATING AQUIFER DISCHARGE,**  
Army Engineer District, Los Angeles, Calif. Flood Plain Management Section.  
D. L. Gundlach.  
Ground Water, Vol 12, No 3, p 135-139, May-June 1974. 5 fig, 1 tab, 4 ref.

Descriptors: \*Water yield, \*Discharge(Water), \*Groundwater movement, \*Darcy's law, Aquifer characteristics, Transmissivity, Artesian aquifers, Confined water, Equations.

Differential equations based on Darcy's equation and the equation of continuity give the steady-flow discharge rate for confined aquifers in which the cross-sectional area and permeability vary from point to point. For the general case the derived discharge expression is theoretically exact, whereas, for specific cases an approximate form can be used depending on the boundary conditions. Integration of the approximate form for a given aquifer length yields simplified solutions for discharges where the variation in cross-sectional area and permeability with distance in the direction of flow can be described by some mathematical expression. (Knapp-USGS)  
W74-09096

**DIGITAL-COMPUTER PROGRAMS FOR ANALYSIS OF GROUND-WATER FLOW,**  
Geological Survey, Little Rock, Ark.  
M. S. Bedinger, J. E. Reed, and J. D. Griffin.  
Open-file report, 1973. 85 p, 10 fig, 4 tab, 9 ref.

Descriptors: \*Computer programs, \*Groundwater movement, \*Surface-groundwater relationships, \*Evapotranspiration, Mathematical models, Water level fluctuations, Hydrogeology, Finite element analysis, Numerical analysis.

Three digital computer programs—GROUND-WATER FLOW, RIVER-INDUCED FLUCTUATIONS, and EVAPOTRANSPIRATION apply digital-computer solutions to previously described mathematical and hydrologic techniques. The GROUNDWATER FLOW program computes the head response in an aquifer to various boundary conditions. The EVAPOTRANSPIRATION program computes the steady-state relation between evapotranspiration and depth to water as a function of thickness and layering of fine-grained material overlying the aquifer. The output from EVAPOTRANSPIRATION is applicable in some problems as boundary criteria in the GROUNDWATER FLOW program. The RIVER-INDUCED FLUCTUATIONS program accepts as input the unit change in stream stage computed by GROUNDWATER FLOW. Using the unit response of the aquifer and a hydrograph of the stream, RIVER-INDUCED FLUCTUATIONS computes the head fluctuations in the aquifer induced by the changes in river stage. (Knapp-USGS)  
W74-09115

**WATER RESOURCES DATA FOR GEORGIA, 1973,**  
Geological Survey, Doraville, Ga.  
For primary bibliographic entry see Field 7C.  
W74-09116

**WATER-LEVEL CHANGES IN NORTHWESTERN KANSAS, 1950-73,**  
Geological Survey, Garden City, Kans.  
For primary bibliographic entry see Field 4B.  
W74-09194

**APPLICATION OF THE GREEN AND COREY METHOD FOR COMPUTING HYDRAULIC CONDUCTIVITY IN HYDROLOGIC MODELING,**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 2G.  
W74-09195

**THE PINE-POPPLE RIVER BASIN—HYDROLOGY OF A WILD RIVER AREA, NORTHEASTERN WISCONSIN,**  
Geological Survey, Washington, D.C.  
For primary bibliographic entry see Field 2E.  
W74-09223

**ANNUAL REPORT ON GROUND WATER IN ARIZONA, SPRING 1972 TO SPRING 1973,**  
Geological Survey, Phoenix, Ariz.

## Field 2—WATER CYCLE

### Group 2F—Groundwater

For primary bibliographic entry see Field 4B.  
W74-09229

## 2G. Water In Soils

**THE IMPROVEMENT OF POOR STRUCTURED BASIN DEPRESSION SOILS AT FUDHALIYA EXPERIMENTAL FIELD,**  
Institute for Applied Research on Natural Resources, Baghdad (Iraq).  
For primary bibliographic entry see Field 3C.  
W74-08763

**PENETRABILITY AND HYDRAULIC CONDUCTIVITY OF DILUTE SULFURIC ACID SOLUTIONS IN SELECTED ARIZONA SOILS,**  
Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.  
S. Miyamoto, J. Ryan, and H. L. Bohn.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proc. of the 1973 meetings of the Arizona Section-AWRA and the Hydrology Section-Arizona Academy of Science, May 4-5, 1973, Tucson, Arizona, p 55-62, (1973). 6 fig, 2 tab, 12 ref.

Descriptors: \*Hydraulic conductivity, \*Penetration, \*Calcareous soils, \*Sodium, Sulfur, Sulfides, Acids, Acid mine water, Soils, Carbonates, Neutralization, Salts, Carbon dioxide, Arizona, Alkali soils.  
Identifiers: \*Sulfuric acid, Saturation point.

Measurements of penetrability and hydraulic conductivity in calcareous soils treated with a dilute sulfuric acid solution showed a severe decrease in conductivity with increasing concentrations over 1000 ppm. A slight decrease in penetrability was observed. Carbon dioxide evolution appeared to be responsible for flow reduction and temporary cessation at 10,000 ppm and 20,000 ppm. In sodic soils penetrability and conductivity increased markedly with sulfuric acid concentrations between 1,000 and 10,000 ppm. For a neutral soil, penetrability decreased with increasing sulfuric acid concentrations, and the stable conductivity for 500 to 5,000 ppm was higher than for water alone. The findings suggest that disposal of sulfuric acid concentrations greater than 1,000 ppm will result in plugging by carbon dioxide. In sodic soils the possibility exists of using sulfuric acid solutions for reclaiming salt and sodium-affected soils. (Mastic-Arizona)  
W74-08765

**A JEEP-MOUNTED RAINFALL SIMULATING INFILTROMETER,**  
Northern Arizona Univ., Flagstaff.  
For primary bibliographic entry see Field 7B.  
W74-08766

**FACTORS AFFECTING THE PERSISTENCE OF PESTICIDES IN THE SOIL,**  
Rothamsted Experimental Station, Harpenden (England).  
For primary bibliographic entry see Field 5B.  
W74-08793

**INTERACTION EFFECTS OF BORON AND LIME ON BARLEY,**  
Department of Agriculture, Charlottetown, (Prince Edward Island), Research Station.  
For primary bibliographic entry see Field 3F.  
W74-08799

**EFFECT OF SUPPLEMENTAL WATER ON BARLEY AND CORN PRODUCTION IN A SUB-HUMID REGION,**  
Agricultural Research Service, Northern Great Plains Research Center, Mandan, N.D.  
For primary bibliographic entry see Field 3F.  
W74-08803

**YIELD RESPONSE OF SOYBEAN VARIETIES GROWN AT TWO SOIL MOISTURE STRESS LEVELS,**  
Ohio Agricultural Research and Development Center, Wooster.  
For primary bibliographic entry see Field 3F.  
W74-08805

**NITROGEN METABOLISM OF STARGRASS AS AFFECTED BY NITROGEN AND SOIL SALINITY,**  
Department of Agriculture, Watkinsville, Ga.  
For primary bibliographic entry see Field 3C.  
W74-08806

**IONIC BALANCE FOR BARLEY AS INFLUENCED BY P FERTILITY, WATER, AND SOIL TEMPERATURE,**  
Agricultural Research Service, Northern Great Plains Research Center, Mandan, N. Dak.  
For primary bibliographic entry see Field 3F.  
W74-08810

**WATER STRESS RELATIONS OF THE POTATO PLANT UNDER FIELD CONDITIONS,**  
Agricultural Research Service, Orono, Maine.  
For primary bibliographic entry see Field 3F.  
W74-08811

**COTTON LEAF TEMPERATURES AS RELATED TO SOIL WATER DEPLETION AND METEOROLOGICAL FACTORS,**  
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
For primary bibliographic entry see Field 3F.  
W74-08812

**EFFECT OF LONG-TERM MANAGEMENT ON PHYSICAL AND CHEMICAL PROPERTIES OF THE COSHOCTON WATERSHED SOILS,**  
Agricultural Research Service Coshocton, Ohio, North Appalachian Experimental Watershed.  
For primary bibliographic entry see Field 4D.  
W74-08813

**CALCIUM-MAGNESIUM-POTASSIUM EQUILIBRIA IN SOME CALIFORNIA SOILS,**  
California Univ., Davis. Dept. of Pomology.  
R. M. Carlson, and J. R. Buchanan.  
Soil Science Society of America Proceedings, Vol 37, No 6, p 851-855, November-December, 1973. 5 fig, 3 tab, 19 ref.

Descriptors: \*Salinity, \*Ion exchange, Ions, Leaching, Fertilizers, \*Potassium, Nutrient removal, Equilibrium, \*California, \*Calcium, \*Magnesium.

Ion exchange equilibria in several soils were studied to seek equilibrium equations that could be used in chromatographic models dealing with movement and distribution of fertilizer potassium in soil profiles. Soil samples were equilibrated with mixtures of CaCl<sub>2</sub>, MgCl<sub>2</sub>, and KCl solutions and then extracted with NH<sub>4</sub>OAc to determine exchangeable cation compositions at equilibrium. It was necessary to correct the exchangeable cation concentrations by subtracting the cations extracted from nonexchangeable sources by NH<sub>4</sub>OAc. Vanselow's, Davis', Gapon's or Kerr's equation would not describe the equilibria. Equations were developed to describe the equilibria. (Skogerboe-Colorado State)  
W74-08814

**FURTHER EVIDENCE FOR THE INABILITY OF THE KJELDAHL TOTAL NITROGEN METHOD TO FULLY MEASURE INDIGENOUS FIXED AMMONIUM NITROGEN IN SUBSOILS,**  
Nebraska Univ., Lincoln. Agricultural Experiment Station.  
V. W. Meints, and G. A. Peterson.

Soil Science Society of America Proceedings, Vol 36, No 3, p 434-436, May-June, 1972. 2 tab, 6 ref.

Descriptors: \*Fertility, \*Nutrients, \*Nitrogen, \*Soil chemical properties, Subsoil, Nitrates.  
Identifiers: \*Ammonium-nitrogen.

Three methods of Kjeldahl total N determinations in soils were compared. Method 1 involved a pretreatment of the soil with a HF-acid mixture and resulted in higher N values than methods 2 or 3 which involved a long period of digestion and a modification of a Gunning method, respectively. Differences in total N values obtained by the three methods were greatest for subsoils. The inability of methods 2 and 3 to measure all of the indigenous fixed ammonium-nitrogen resulted in low N values and erroneously high C:N ratios in the subsoil. (Skogerboe-Colorado State)  
W74-08819

**AVAILABLE PHOSPHORUS LEVEL VARIATIONS OCCURRING DURING THE RECLAMATION OF AN ALKALINE-SALTY SOIL (VARIACIONES DEL TENOR DE FOSFORO ASIMILABLE DURANTE LA RECUPERACION DE UN SUELO SALINO-ALCALINO),**  
Estacion Experimental de Riego y Cultivos, Viedma (Argentina). Tecnico en Fertilidad de Suelos. R. S. Lavado.  
Anales de la Sociedad Cientifica Argentina, Vol 5, No 195, 2nd Series Applied Science, No 33, p 135-141, March-June, 1973. 4 fig, 2 tab, 11 ref.

Descriptors: \*Phosphorus, \*Soils, \*Saline soils, \*Alkaline soils, Calcium sulfate, \*Flooding, Gypsum.  
Identifiers: \*Argentina(Rio Negro).

The evolution of available phosphorus in a salty-alkaline soil of the Lower Valley of the Rio Negro was investigated. In general, flooding is thought to cause an increase of the available phosphorus in the soil. Calcium sulfate also seems to increase the availability of phosphorus. Soil was flooded several times with big sheets of water after applying gypsum. The results show that, statistically, there were no significant variations in the amount of available phosphorus. (Merritt-FRL)  
W74-08822

**SOIL CRUSTING RELATED TO SPRINKLER INTENSITY,**  
Auburn Univ., Ala. Dept. of Agricultural Engineering.  
For primary bibliographic entry see Field 3F.  
W74-08844

**CONTROLLED INSTANTANEOUS APPLICATION OF FREE WATER TO A POROUS SURFACE,**  
Purdue Univ., Lafayette, Ind. Dept. of Agronomy. S. D. Swartzendruber, and M. S. Asseel.  
Soil Science Society of America Proceedings, Vol 37, No 6, p 967-968, November-December, 1973. 1 fig. OWRR B-014-IND(7).

Descriptors: \*Porous media, \*Infiltration, Seepage, \*Flow measurement, Control systems, Pressure head.  
Identifiers: Water application.

Instantaneous application of free water to a porous-medium surface is achieved essentially by a device in which the central feature is a plastic plate perforated with small holes. The pressure head of the water can be controlled at a preselected value between 0 and 1 cm. Water enters the porous medium at essentially zero external flow resistance, while volume and time of entry can be measured accurately. No lateral flow of free water occurs, thus eliminating the disturbing effects of such flow on the porous-medium surface. (Sandoski-Franklin)  
W74-08883

**GE(LI) LOW LEVEL IN SITU GAMMA-RAY SPECTROMETER APPLICATIONS,**  
California Univ., Livermore. Lawrence Livermore Lab.  
For primary bibliographic entry see Field 5A.  
W74-08886

**THE EFFECT OF EXCLUSION VOLUME ON POTENTIOMETRIC NITRATE MEASUREMENT,**  
Arkansas Univ., Fayetteville. Dept. of Agronomy.  
J. T. Gilmour, and H. D. Scott.  
Soil Science Society of America Proceedings, Vol 37, No 6, p 959-960, November-December, 1973. 1 fig, 2 tab, 10 ref.

Descriptors: \*Nitrates, Nitrogen, \*Clays, \*Montmorillonite, Measurement, \*Soils.  
Identifiers: \*Potentiometric measurement.

Data are presented which show that large anion exclusion volumes can occur when montmorillonitic soils, low in total salt, are extracted with water. Nitrate measurements on such extracts with the nitrate specific ion electrode reflect this exclusion volume induced error. A possible solution to the problem is suggested. (Skogerboe-Colorado State)  
W74-08919

**INTERACTING DIFFUSE LAYERS IN MIXED MONO-DIVALENT IONIC SYSTEMS,**  
Volcani Inst. of Agricultural Research, Bet Dagan (Israel).  
E. Bresler.  
Soil Science Society of America Proceedings, Vol 36, No 6, p 891-896, November-December, 1972. 7 fig, 1 tab, 19 ref.

Descriptors: \*Cation exchange, \*Cations, Analog computers, Computer models, \*Ion exchange, Soils, Clays.

A numerical solution of the electric double-layer problem for the case of overlapping diffuse layers in mixed monovalent-divalent ion systems, is used to obtain a series of graphs for various cation compositions in the external solution. In these graphs, the electric potential is expressed as a function of the surface charge density, the concentration of the two cations in the equilibrium solution, and the distance between platelets in various ionic mixtures. The graphs cover most of the situations usually encountered in soil systems, and are not sensitive to the valency of the anions present. They are used to estimate the electrostatic effect on cation exchange equilibria, swelling pressures, and electrokinetic phenomena in mixed-ion clay systems. Application of these estimates to theoretical analyses and comparisons between theoretical models and experimental data are illustrated. Some of the examples used for this illustration are based on work previously published by others. (Skogerboe-Colorado State)  
W74-08920

**WASTE ACCUMULATION ON A SELECTED DAIRY CORRAL AND ITS EFFECT ON THE NITRATE AND SALT OF THE UNDERLYING SOIL STRATA,**  
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.  
A. G. Hornsby, and J. M. Davidson.  
Soil Science Society of America Proceedings, Vol 37, No 6, p 823-828, November-December, 1973. 7 fig, 2 tab, 12 ref.

**SOLUTION AND ADSORBED FLUOMETURON CONCENTRATION DISTRIBUTION IN A WATER-SATURATED SOIL: EXPERIMENTAL AND PREDICTED EVALUATION,**  
Environmental Protection Agency, Ada, Okl.  
A. G. Hornsby, and J. M. Davidson.  
Soil Science Society of America Proceedings, Vol 37, No 6, p 823-828, November-December, 1973. 7 fig, 2 tab, 12 ref.

Descriptors: \*Adsorption, Solutes, \*Soil water, Soil moisture, Salinity, Measurement, Mathematical models.  
Identifiers: \*Desorption, Miscible displacement, Dispersion coefficient, \*Solute transport model, \*Fluometron.

A technique is described for measuring the solution and adsorbed phases of fluometuron in water-saturated soil columns. The data reveal that at an average pore-water velocity of 5.5 cm/hour, the solution and adsorbed phases of fluometuron are not in equilibrium, whereas, at the 0.59 cm/hour velocity they were in equilibrium. The kinetic rate equations for adsorption and desorption were not significantly better than the equilibrium model when describing the fast displacement of fluometuron through soils. The desorption distribution coefficient was found to be a function of the maximum amount of herbicide adsorbed prior to desorption. The experimental data were reasonably well described by the mathematical model. (Skogerboe-Colorado State)  
W74-08924

**EVALUATION OF GRADED FURROW IRRIGATION WITH LENGTH OF RUN ON A CLAY LOAM SOIL,**  
Agricultural Research Services, Bushland, Tex. Southwestern Great Plains Research Center.  
For primary bibliographic entry see Field 3F.  
W74-08927

**DYNAMIC SIMULATION OF AUTOMATED SUBSURFACE IRRIGATION SYSTEMS,**  
Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.  
For primary bibliographic entry see Field 3F.  
W74-08931

**FURROW IRRIGATION CRITERIA FOR HAWAIIAN SUGARCANE,**  
Hawaiian Sugar Planters' Association Experiment Station, Honolulu.  
For primary bibliographic entry see Field 3F.  
W74-08932

**SUITABILITY OF NEW MEXICO LANDS FOR IRRIGATION,**  
New Mexico State Univ., University Park. Dept. of Agronomy.  
For primary bibliographic entry see Field 3F.  
W74-09055

**SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, MCKINLEY COUNTY,**  
New Mexico State Univ., University Park. Dept. of Agronomy.  
For primary bibliographic entry see Field 3F.  
W74-09056

**SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, VALENCIA COUNTY,**  
New Mexico State Univ., University Park. Dept. of Agronomy.  
For primary bibliographic entry see Field 3F.  
W74-09057

**APPLICATION OF THE GREEN AND COREY METHOD FOR COMPUTING HYDRAULIC CONDUCTIVITY IN HYDROLOGIC MODELING,**  
Oak Ridge National Lab., Tenn.  
R. J. Luxmoore.  
Available from NTIS, Springfield, Va. 22151 as EDB-IBP-73-4 Price \$3.00 printed copy; \$1.45 microfiche. International Biological Program Report EDB-IBP-73-4, April 1973. 22 p, 11 ref., append.

Descriptors: \*Hydraulic conductivity, \*Soil water movement, \*Computer programs, Saturated flow, Unsaturated flow.

The Green and Corey method for computing the relationship of hydraulic conductivity and soil water content was implemented as a subroutine (SOIL) and coupled with a table lookup subroutine (TABLOK) for use in soil-water modeling at several sites in the Eastern Deciduous Forest Biome. Readily available input data (water content vs pressure, saturated conductivity) are used in the SOIL subroutine to compute unsaturated conductivity. Three data arrays (water content, pressure, conductivity) are set up in SOIL and used in TABLOK such that at a given value of soil-water content the corresponding values for pressure and conductivity are calculated by linear interpolation. Outlines of the computational methods and program listings are given together with example calculations. Two modified methods for calculating conductivity are compared with the Green and Corey method. One modification uses an unsaturated conductivity matching value. The other uses a linearly weighted matching factor, based on both saturated and unsaturated conductivity values. Any one of the three methods can be used in the SOIL-TABLOK subroutines. The package can provide an effective bridge between available data and the input data requirements of a physically based soil-water model. (Knapp-USGS)  
W74-09195

**SEISMIC REFRACTION ANALYSIS OF WATERSHED MANTLE RELATED TO SOIL, GEOLOGY, AND HYDROLOGY,**  
Forest Service (USDA), Rapid City, S. Dak. Rocky Mountain Forest and Range Experiment Station.  
T. Yamamoto.  
Water Resources Bulletin, Vol 10, No 3, p 531-546, June 1974. 8 fig, 3 tab, 15 ref.

Descriptors: \*Seismic studies, \*Soil water movement, \*Rainfall-runoff relationships, \*Hydrogeology, Water balance, Alpine, Infiltration, Data collections, Geophysics, Sampling, Subsurface investigations, Hydrograph analysis, Cores, Duration curves, \*South Dakota.

A seismic refraction survey was carried out in three contiguous watersheds (217, 89, and 190 acres) on a laccolith near Sturgis, South Dakota. Isopachs, area-elevation curves (hypsometry), and structure contours were used together with drill cores, petrography, hydrographs, and soil information to interpret the nature and role of porous mantle in the behavior of the watersheds. Refraction profiles produced only one geologically meaningful seismic contrast within the laccolith. Drill cores indicated a shallow stony profile on a sheeted horizon terminating on isotropic crystalline rock impervious except for tight joints. Refraction and core interpretations were not statistically different. Apparent seismic discontinuities deeper within the bedrock lacked geological identity. Storm hydrographs and water yields are better related to soil type differences and porous mantle distribution than to average porous mantle depth. Slopes of flow-duration curves correlate with average porous mantle depth. Porous mantle isopachs, hypsometry, and soil type delineation are complementary in interpretation of watershed behavior. (Knapp-USGS)  
W74-09199

**PARTIAL AREA HYDROLOGY AND ITS APPLICATION TO WATER RESOURCES,**  
Agricultural Research Service, University Park, Pa. Northeast Watershed Research Center.  
For primary bibliographic entry see Field 2A.  
W74-09200

## Field 2—WATER CYCLE

### Group 2G—Water In Soils

**SOIL RESPIRATION IN DIFFERENT TYPES OF SOUTHEAST ASIAN TROPICAL RAIN FOREST, (IN GERMAN),** Zurich Univ. (Switzerland). Institut fuer Allgemeine Botanik. H. Wanner, S. Soerohaldoko, P. D. Natalia, G. Panggabean, and P. Yingchoi. *Oecologia (Berl)*. Vol 12, No 3, p 289-302, 1973. (English summary).  
Identifiers: Forests, Precipitation(Atmospheric), \*Soil respiration, Teak, Tropical rain forests, \*Asia(Southeast).

Soil respiration was measured in different types of rain forest in West, South, and East Java and in Sarawak, North Borneo. The altitude of the experimental sites varied from sea level to 1500 m. In keeping with the different amounts and distribution of precipitation during the year, and due to the very different soil types, vegetation varied from lowland to montane rain forest, teak forest, monsoon forest and heath forest. In all these forest types soil respiration values were of the same order of magnitude. They indicate an oxidation of 10-13 tons organic matter/ha/yr. In some of the experimental sites soil respiration was measured during the rainy as well as during the dry season. The values obtained justify extrapolation to a yearly average. The difficulties connected with interpretation of the soil respiration values as equivalent to net production of the different forest types were discussed.—Copyright 1974, Biological Abstracts, Inc.  
W74-09246

**WATER LOSS FROM AN IRRIGATED SORGHUM FIELD: I. WATER FLUX WITHIN AND BELOW THE ROOT ZONE,** South Dakota State Univ., Brookings. Dept. of Plant Science.  
For primary bibliographic entry see Field 3F.  
W74-09248

### 2H. Lakes

**EFFECTS OF ICE FORMATION ON THE SALT REGIME OF A RESERVOIR (VLIYANIYE LEDOOBRAZOVANIYA NA SOLEVOY REZHIM VODOKHRANILISHCHA),** Vsesoyuznyi Nauchno-Issledovatel'skii Institut Vodnabzheniya, Kanalizatsii, Gidrotekhnicheskikh Sooruzhenii i Inzhenerno Gidrogeologii, Moscow (USSR).  
For primary bibliographic entry see Field 2C.  
W74-08704

**LACUSTRINE SALT DEPOSITS UNDER PRESENT-DAY SEDIMENTS OF THE ARAL SEA (SOIYANYE OZERNYE OTLOZHENIYA POD SOVREMENNymi OSADKAMI ARAL'SKOGO MORYA),** Akademiya Nauk Uzbekskoi SSR, Tashkent. Institut Geologii i Geofiziki. I. V. Rubanov. *Uzbekskiy Geologicheskii Zhurnal*, No 1, p 73-76, 1974, 1 fig, 1 tab, 4 ref.

Descriptors: \*Lakes, \*Saline lakes, \*Salts, \*Lake sediments, Bottom sediments, Marl, Silts, Clays, Sands, Maps.  
Identifiers: \*USSR(Aral Sea).

The Aral Sea is a comparatively shallow-water basin. Mean depth is 15-20 m, and maximum depth is 62 m near the western shore. Maximum length from southwest to northeast is 428 km, and maximum width from west to east is 284 km. Marl, which occupies the central part and western deep-sea areas is predominant among bottom sediments of the sea. Silts, sands, and clays are less developed. The presence of water-soluble salts among the marine sediments attests to complete disappearance of the sea at the time and to transformation of the sea into small dry saline lakes.

The Aral Sea was formed 700-1,000 years ago, which is confirmed by data on rate of accumulation of muds above the saline deposits (0.7-0.8 mm/yr). By analogy with the structure of present-day saline lakes in Soviet Central Asia it may be assumed that the thickness of the mirabilite layer under bottom sediments of the sea will be of the order of 1 m. Areas of major buried salt deposits probably reach 1,000 sq km. (Josefson-USGS)  
W74-08712

**MAN-MADE LAKES: THEIR PROBLEMS AND ENVIRONMENTAL EFFECTS,**  
For primary bibliographic entry see Field 4A.  
W74-08747

**LAKE MEAD, A CASE HISTORY,** Bureau of Reclamation, Denver, Colo.  
For primary bibliographic entry see Field 4A.  
W74-08748

**SEEPAGE LOSSES FROM LAKE NASSER,** High Dam Authority, Cairo (Egypt).  
For primary bibliographic entry see Field 4A.  
W74-08750

**ECOSYSTEM OF THE SALTON SEA,** California State Univ., Long Beach. Dept. of Microbiology.  
For primary bibliographic entry see Field 4A.  
W74-08752

**LIGHT AND TEMPERATURE RELATIONS IN A SMALL DESERT POND AS INFLUENCED BY PHYTOPLANKTONIC DENSITY VARIATIONS,** Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
For primary bibliographic entry see Field 5C.  
W74-08758

**SEASONAL CHANGES OF THE FEEDING OF THE ROACH IN THE MOZHAISK RESERVOIR (IN RUSSIAN),** Moscow State Univ. (USSR). Dept. of Ichthyology.  
E. A. Zadorozhnaya. *Biol Nauki*, Vol 15, No 9, p 31-34, 1972, Illus.  
Identifiers: Algae, Detritus, Insect larvae, Plankton, Reservoirs, \*Roach, *Rutilus-rutilus*, \*Seasonal, \*USSR(Mozhaisk reservoir), Zooplankton, Fish diets.

An investigation of the seasonal change of feeding of the roach (*Rutilus rutilus*) at age 4-11 yr in the Mozhaisk reservoir (USSR) showed that in the spring and early summer macrophytes, plant detritus, algae, and insect larvae predominated in the food of the roach and during the summer-fall and winter periods zooplankton of the pelagic zone predominated. The general direction in the seasonal change of feeding consisted in a decrease of aquatic vegetation and benthic food objects from spring to summer and a change to feeding on limnoplankton in the summer-fall period.—Copyright 1973, Biological Abstracts, Inc.  
W74-08762

**LAKE POWELL RESEARCH PROJECT: HYDROLOGIC RESEARCH,** California Univ., Los Angeles. Inst. of Geophysics. G. C. Jacoby.  
In: *Hydrology and Water Resources in Arizona and the Southwest*, Proc. of the 1973 meetings of the Arizona Section, AWWA, and the Hydrology Section-Arizona Academy of Science, May 4-5, 1973, Tucson, Arizona, p 119-123, (1973).

Descriptors: Hydrology, \*Limnology, \*Geochemistry, \*Streamflow, Evaporation, Bank storage, Sedimentation, Dendrochronology,

Colorado River, \*Arizona, \*Nevada, Data collections.  
Identifiers: \*Lake Powell.

Two administrative institutions, the University of California at Los Angeles and Dartmouth College, are undertaking several subprojects designed to investigate the hydrology of the Lake Powell region. The subprojects include studies of streamflow trends, evaporation, bank storage, sedimentation, physical limnology, and lake geochemistry. The project is concluding its first year of full-scale research. The first year of research has been devoted to setting up data collection systems and some tentative conclusions have been reached. More specific results will be furnished in the second year, particularly in regard to water budget and limnology of Lake Powell. (Mastic-Arizona)  
W74-08767

**PHOSPHORUS AND CARBON IN LAKE POLLUTION,** Basf-Wyandotte Chemical Corp., Mich.  
For primary bibliographic entry see Field 5C.  
W74-08775

**COMPREHENSIVE MANAGEMENT OF PHOSPHORUS WATER POLLUTION,** Utah Water Research Lab., Logan.  
For primary bibliographic entry see Field 5C.  
W74-08826

**VERTICAL DISTRIBUTION OF MICROBIAL PLANKTON IN SOUTHERN PART OF LAKE BAIKAL IN 1969, (IN RUSSIAN),** Biologo-Geograficheskii Nauchno-Issledovatel'skii Institut, Irkutsk (USSR).  
For primary bibliographic entry see Field 5C.  
W74-08870

**DISTRIBUTION OF PHOSPHATES IN LAKE MARIUT, A HEAVILY POLLUTED LAKE IN EGYPT,** Alexandria Univ. (Egypt). Dept. of Oceanography.  
For primary bibliographic entry see Field 5B.  
W74-08881

**DISTRIBUTION OF SELECTED TRACE METALS IN SOUTHERN LAKE MICHIGAN AND LOWER GREEN BAY,** Illinois Univ., Urbana. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5B.  
W74-08934

**A STUDY OF THE EUTROPHICATION OF THE SURFACE WATERS OF PYRAMID LAKE,** Nevada Univ., Reno. Dept. of Chemical and Metallurgical Engineering.  
For primary bibliographic entry see Field 5C.  
W74-08938

**FINAL ENVIRONMENTAL STATEMENT RELATED TO OPERATION OF NINE MILE POINT NUCLEAR STATION UNIT 1.** Directorate of Licensing (AEC), Washington, D.C.  
Aval: NTIS, Springfield, Va., as Rept. No. Docket 50220-227; \$10.60/copy, \$1.45 microfiche. Report No. Docket 50220-227, January 1974. 471 p, 36 fig, 44 tab, 108 ref, 3 append.

Descriptors: \*Lake Ontario, \*Nuclear powerplants, Effluents, Environment, Administrative agencies, Comprehensive planning, \*Sites, Geology, Investigations, Hydrology, Seismology, Climatology, Meteorology, Ecology, Radioactive wastes, Water pollution, Water pollution sources, Radioactive effects, Monitoring, Public health, Transportation, Beneficial use, Cost-benefit analysis, \*New York.  
Identifiers: \*Environmental Impact Statement, \*Boiling water reactors.

This final environmental statement was prepared in compliance with the National Environmental Policy Act and relates to the proposed conversion of the current provisional operating license to a full-term license for the Nine Mile Point Nuclear Station Unit 1. The plant is located on Lake Ontario in the state of New York and will employ a boiling-water reactor cooled by once-through flow of water obtained from and discharged to Lake Ontario. Environmental impacts are assessed and after consideration of alternatives an environmental benefit-cost summary was compiled. Environmental factors considered include climate, hydrology (surface water and ground water), ecology including aquatic life, cooling-water supply and discharge, cooling towers, cooling lakes, spray ponds, radioactive chemical and sanitary wastes, amount of dissolved oxygen and toxic chemicals in effluent water. The conclusion is to convert the current provisional operating license to a full-term license for the facility subject to the following conditions: (1) construct a new radwaste facility; (2) establish a revised and comprehensive environmental monitoring program; (3) provide an analysis and course of action for any evidence for potential irreversible damage detected. (Houser-ORNL)

W74-08960

**THE DISTRIBUTION OF COBALT-60 RUTHEMIUM-106 AND CESIUM-137 AMONG SUSPENDED AND DISSOLVED PARTICLES IN WHITE OAK LAKE,**  
Oak Ridge Gaseous Diffusion Plant, Tenn.  
For primary bibliographic entry see Field 5B.  
W74-08964

**PROTOCOL FOR EVALUATING THE NITROGEN STATUS OF LAKE SEDIMENTS,**  
Wisconsin Univ., Madison. Dept. of Soil Science.  
For primary bibliographic entry see Field 5C.  
W74-09065

**DAILY VERTICAL DISTRIBUTION OF WINTER ZOOPLANKTON IN THE PELAGIC ZONE OF LAKE BAIKAL, (IN RUSSIAN),**  
Kalininskii Tekhnicheskii Institut Rybnoi Promyshlennosti i Khozyaistva (USSR).  
For primary bibliographic entry see Field 5C.  
W74-09074

**PROBLEMS OF THE REGIME AND INVESTIGATION OF LAKES AND RESERVOIRS (VOPROSY REZHIMA I ISSLEDOVANIYA OZER I VODOKHRANILISHCH),**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, Znamskiy, V. A., editor, Leningrad, 1973. 268 p.

Descriptors: \*Lakes, \*Reservoirs, \*Water balance, \*Hydrologic cycle, \*Currents(Water), Flow, Precipitation(Atmospheric), Discharge(Water), Runoff, Evaporation, Stratification, Thermal properties, Circulation, Waves(Water), Winds, Water levels, Floats, Current meters, Statistical methods, Mapping.  
Identifiers: \*USSR, \*Lake Baykal, Water exchange, Meromictic lakes, Metalimnion, Longshore currents, Gradient currents, Drift currents, Geostrophic currents, Spectrum analysis.

Hydrologic regimes of large bodies of water are discussed in this collection of 14 papers prepared by the Department of Lakes and Reservoirs of the State Hydrologic Institute and by lake hydrometeorological observatories, and stations. Subjects discussed include: (1) water balance of Lake Baykal; (2) refinement of the precipitation amount as applied to calculation of water balance of Lake Baykal; (3) on-site investigations of currents in the southern part of Lake Baykal; (4) internal water exchange and turbulence in Lake

Baykal; (5) application of a dynamic height method to investigations of currents in inland bodies of water; (6) long-term characteristics of the temperature regime of Lake Ladoga; (7) depth distribution of water temperature in the Kakhovka Reservoir; (8) thermal characteristics and vertical exchange in meromictic lakes as illustrated by Lake Gek-Gel'; (9) comparative estimation of energy losses in water bodies and in tranquil and turbulent flows; (10) statistical and spectrum analyses of wind waves on the Kayrakkum Reservoir; (11) aircraft determinations of wind velocity and direction above a water surface; (12) techniques of ship measurement of currents by current meters and floats; (13) volume of water in rivers, lakes, and reservoirs of the Soviet Union; and (14) water balance of world lakes and reservoirs. (See W74-09101 thru W74-09112) (Josefson-USGS)  
W74-09100

**WATER BALANCE OF LAKE BAYKAL (VODNYI BALANS OZ. BAYKAL),**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

Z. A. Vikulina, and T. D. Kashinova.  
In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch: Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 3-33, Leningrad, 1973. 1 fig, 22 tab, 15 ref.

Descriptors: \*Lakes, \*Water balance, \*Hydrologic cycle, Inflow, Precipitation(Atmospheric), Discharge(Water), Runoff, Evaporation, Water levels, Water level fluctuations, Lake basins, Watersheds(Basins).  
Identifiers: \*USSR(Lake Baykal).

Water balance of Lake Baykal was refined on the basis of recent observations and calculations. A comparison of data on items in the water balance of the lake for a 70-year period (1901-70) and for the last 38 years (1933-70) shows that variations in surface inflow, lake runoff, and lake level fluctuations do not exceed 2%-5%. Maximum differences occur in determination of evaporation and precipitation values, which, according to calculations by the State Hydrologic Institute on data from 1933-70, increased by more than 40% over those obtained by earlier investigators. The volume of water actually participating in the hydrologic cycle of the lake is 73 cu km as compared with 70 cu km established earlier. Nonuniform inflow and discharge of water in different parts of the lake contribute to intensified circulation of water masses. The annual volume of water flowing from the northern part of the lake to the southern part through the Selenga shoals is 36 cu km. (See also W74-09100) (Josefson-USGS)  
W74-09101

**REFINEMENT OF THE PRECIPITATION AMOUNT AS APPLIED TO CALCULATION OF WATER BALANCE OF LAKE BAYKAL, (UTOCHNENIYE VELICHINY OSADKOV PRIMENITEL'NO K RASCHETU VODNOGO BALANSA OZ. BAYKAL),**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

A. A. Natrus, and I. A. Mukhacheva.  
In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch: Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 34-48, Leningrad, 1973. 1 fig, 9 tab, 26 ref.

Descriptors: \*Lakes, \*Water balance, \*Precipitation(Atmospheric), Precipitation gages, Rain gages, Gaging stations, Winds, Evaporation, Mapping, Isohyets.  
Identifiers: \*USSR(Lake Baykal), Tret'yakov precipitation gages.

Assessment of precipitation is very important in determining its role in the water balance of Lake Baykal. A number of corrections must be applied to precipitation-gage readings to assess the amount of precipitation on the water surface. The most im-

portant corrections to be applied are those of the effect of wind on the instruments, precipitation losses to wetting of the precipitation gage (bucket), and precipitation losses to evaporation from the bucket. To obtain a uniform long-term precipitation evaluation, a correction must be allowed for reducing the precipitation amounts measured by rain gages standing 2 m high and surrounded by a shield to the precipitation amounts measured by Tret'yakov precipitation gages. As compared with earlier calculations, refinement of the precipitation amount for Lake Baykal was 100 mm, i.e., 25% of the long-term average. (See also W74-09100) (Josefson-USGS)  
W74-09102

**RESULTS OF ON-SITE INVESTIGATIONS OF CURRENTS IN THE SOUTHERN PART OF LAKE BAYKAL (REZULTATY NATURNYKH ISSLEDOVANIY TECHENIY V YUZHNOY BAYKALE),**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

M. M. Aynbund.  
In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch: Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 49-70, Leningrad, 1973. 7 fig, 10 tab, 11 ref.

Descriptors: \*Lakes, \*Currents(Water), \*On-site investigations, Mapping, Water circulation, Movement, Velocity, Rates, Winds, Ice cover, Flow measurement, Current meters, Floats, Buoys, Seasonal.  
Identifiers: \*USSR(Lake Baykal), Longshore currents.

Currents in the southern part of Lake Baykal were measured in 1965-67 during the ice-free season and during the period of complete ice cover. The major factor in the formation of currents in the southern part of the lake during the ice-free season is that of wind. The effects of other factors are negligible. The stability of prevailing currents varies throughout the lake and increases from summer to fall. Average current velocities in the southern part of the lake during the navigation period vary between 12 and 18 cm/sec at a depth of 15 m and between 4 and 8 cm/sec at a depth of 50 m. Current velocity generally increases significantly from summer to fall. Influence of the bank manifests itself in the 1-1.5 km-wide littoral zone and is reflected in lower (by a factor of 2-2.5) velocities of longshore currents and in formation of eddies of varying types and sizes. As a result, transport is considerably less in the littoral zone than at a distance of 1.5-3 km from the bank. A prevailing cyclonic cycle formed before start of complete ice cover is retained in upper layers under the ice. Current velocities in winter are negligible in all regions in the southern part of the lake. Local circulations and eddies produced by turbulence are strongly developed in deep layers (900-1,200 m) during complete ice cover. (See also W74-09100) (Josefson-USGS)  
W74-09103

**PROBLEM OF THE PROCESSES OF INTERNAL WATER EXCHANGE AND TURBULENCE IN LAKE BAYKAL (K VOPROSU O PROTSESSAKH VNUTRENNEGO VODOOBMENA I TURBULENTNOSTI NA OZ. BAYKAL),**  
Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

V. A. Znamskiy.  
In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch: Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 71-79, Leningrad, 1973. 4 fig, 2 tab, 5 ref.

Descriptors: \*Lakes, \*Turbulence, \*Water circulation, Movement, \*Water chemistry, Mixing, Eddies, Dissolved solids, Littoral, Surveys, Mapping, Equations.  
Identifiers: \*USSR(Lake Baykal), \*USSR(Selenga River), \*Water exchange, Mineralization.

## Field 2—WATER CYCLE

### Group 2H—Lakes

Internal exchange of water between individual parts of the lake, character of turbulence in the littoral zone, and distribution of waters of the Selenga River were investigated in hydrochemical surveys in the southern part of Lake Baykal in 1967-69. The surveys were performed by an expedition of the Hydrochemical Institute of the Main Administration of the Hydrometeorological Service (GUGMS) and were conducted at the surface, mid-depth, and bottom of the lake. Large-scale turbulent eddies governing the mixing and transport of water masses and dissolved chemical and organic substances were found to exist in the littoral zone of the lake. (See also W74-09100) (Josefson-USGS)  
W74-09104

**A DYNAMIC METHOD AND ITS APPLICATION TO INVESTIGATIONS OF CURRENTS IN INLAND BODIES OF WATER (DINAMICHESKIY METOD I YEGO PRIMENENIYE DLYA ISSLEDOVANIY TECHENIY VO VNUTRENNIKH VODOYEMAKH),** Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
T. V. Rotatova, and T. N. Filatova.

In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 80-124, Leningrad, 1973. 15 fig, 9 tab, 40 ref.

Descriptors: \*Stage-discharge relations, \*Inland waterways, \*Lakes, \*Currents(Water), Bodies of water, Density currents, Height, Depth, Circulation, Water circulation, Air circulation, Velocity, Wind velocity, Winds, Current meters, Water quality, Meteorology, Temperature, Isotherms, Mapping, Equations.  
Identifiers: \*USSR, \*Dynamic height method, Gradient currents, Drift currents, Wind currents, Geostrophic currents, Convective currents.

Possibilities of the dynamic height method for investigation of currents in inland bodies of water are limited by (1) absence of generally accepted concepts of types of currents that can be calculated by this method and (2) absence of sufficiently complete studies summarizing its adaptation to freshwater conditions. Fundamentals of the dynamic method are discussed; possibility of its application to investigation of currents in inland freshwater bodies is considered; computed and observed characteristics of currents are compared; and concepts of the types of currents calculated by the dynamic method are refined. The method is applied to Lakes Ladoga, Issyk-Kul' and Baykal in the Soviet Union, Lakes Huron and Michigan in the United States, Lake Constance (Bodensee) on the border between Germany, Austria, and Switzerland, and Lake Ohrid in southern Yugoslavia and eastern Albania. (See also W74-09100) (Josefson-USGS)  
W74-09105

**LONG-TERM CHARACTERISTICS OF THE TEMPERATURE REGIME OF LAKE LADOGA (MNOGOLETNIYE KHARAKTERISTIKI TEMPERATURNOGO REZHIMA LAZDZHSKOGO OZERA),** Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
V. A. Misyuk.

In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 125-147, Leningrad, 1973. 8 fig, 8 tab, 5 ref, append.

Descriptors: \*Lakes, \*Thermal properties, \*Water temperature, Thermocline, Heat, Heating, Cooling, Shallow water, Deep water, Depth, Littoral, Isotherms, Mapping, Seasonal.  
Identifiers: \*USSR(Lake Ladoga).

The close relation which exists between surface water temperature in the open part of a lake and

temperature recorded by gaging stations can be used to determine 10-day and monthly water temperatures for littoral, intermediate, and deep-water zones as well as for the entire lake. Isotherms, constructed in 1963-70 at different depths during the second phase of spring warming, the summer period, and the first phase of autumnal cooling, give a graphic picture of the distribution of water masses of Lake Ladoga and show that warmest waters are in the southeastern region and that coldest waters are in northern and northwestern regions. The maximum depth of wind mixing is 30 m. At the start of spring warming the thermocline occurs only in the southern shallow-water zone. Cold waters having a temperature of about 4 deg C or less are located at this time in middle and northern parts of the lake. With additional entry of heat into the lake the thermocline in the southern part descends and forms in middle and northern parts of the lake. Maximum temperature gradients are observed in July-August in the upper layers of water to a depth of 10 m. Advection of cold northern water masses into the southern shallow-water part of the lake occurs in July-September. Storage of heat in the lake is calculated, and recommendations call for additional studies of the lake's thermal regime. (See also W74-09100) (Josefson-USGS)  
W74-09106

**DEPTH DISTRIBUTION OF WATER TEMPERATURE IN THE KAKHOVKA RESERVOIR (RASPREDELENIYE TEMPERATURY VODY PO GLUBINE V KAKHOVSKOM VODOKHRANILISHCHE),** Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
V. M. Klaven.

In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 148-160, Leningrad, 1973. 5 fig, 2 tab, 5 ref.

Descriptors: \*Reservoirs, \*Water temperature, \*Depth, \*Distribution, Air temperature, Wind velocity, Thermal stratification, Summer, Fluctuations, Cross sections.  
Identifiers: \*USSR(Kakhovka Reservoir).

Characteristics of the thermal regime of the Kakhovka Reservoir in southeastern Ukraine were investigated in May-August 1970-71. Water temperature in a surface layer in deep water and in a littoral zone in an area of measurement differs only slightly. The range of daily fluctuations in a surface layer during summer months is 1-2 deg C, and only on individual hot days does it reach 6-8 deg C. The difference between surface and bottom water temperatures at the temperature station and at sections across the reservoir is 0.1-0.5 deg C on stormy days but reaches 5-7 deg C on calm, hot days. Four characteristic types of depth distribution of water temperature are identified: (I) isothermal conditions with a temperature difference between surface and bottom layers, not exceeding 0.5 deg C; (II) a smooth temperature drop from surface to bottom, ranging from 0.5 to 1.5 deg C; (III) a sharp temperature drop from the surface to a depth of 1.5-4.0 m, ranging from 1.5 to 7.0 deg C; and (IV) presence of three expressed layers: the epilimnion, metalimnion, and hypolimnion. The temperature difference between surface and bottom layers is 1.5-5.0 deg C. Isothermal conditions (type I) prevail during most (73%) of the summer season. Type III stratification during summer months is more frequent (14%) than type IV stratification (5%), while the duration of type II stratification occupies a middle position (8%). (See also W74-09100) (Josefson-USGS)  
W74-09107

**THERMAL CHARACTERISTICS AND VERTICAL EXCHANGE IN MEROMICTIC LAKES AS ILLUSTRATED BY LAKE GEK-GE' (TERMICHESKIYE OSOBNOSTI I VERTIKAL'NYY OBMEN V MEROMIK-**

**TICHESKIKH OZERAKH NA PRIMERE OZ. GEK-GE'),** Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

T. N. Filatova, and M. A. Fortunatov.

In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 161-185, Leningrad, 1973. 6 fig, 5 tab, 57 ref.

Descriptors: \*Lakes, \*Meromixis, \*Water circulation, \*Thermal properties, Water temperature, Thermal stratification, Thermocline, Thermal conductivity, Convection, Turnovers, Seasonal, Mixing, Mixolimnion, Epilimnion, Hypolimnion, Probability, Curves, Equations.  
Identifiers: \*USSR(Lake Gek-Ge'), \*Meromictic lakes, Metalimnion, Monimolimnion, Thermoisopleths.

Lake Gek-Ge' is located in Azerbaydzhan, 30 km south of Kirovabad, at a height of 1,650 m above sea level on slopes of the Morov-Dag mountain range. The area of the lake is 0.79 sq km; length is 2.5 km; and maximum width is 0.5 km. Maximum depth, which is about 100 m, occurs in the middle part of the lake. The shape of the lake basin is conical. Distribution of water temperature on the lake surface is similar to that on the surface of lakes in temperate latitudes. The water layer of the mixolimnion of the lake in May-November is divided into the epilimnion, metalimnion, and hypolimnion. The metalimnion is the most clearly expressed. Maximum temperature gradients in it are observed in July and reach 5 deg/m or more. In July-August the probability of vertical temperature gradients of about 1 deg/m is 99%, that of 2 deg/m—50% and that of 5 deg/m or more—1%. A stable temperature approaching 5 deg is maintained throughout the year in the monimolimnion located at a depth below 20 m. In July-August vertical exchange in the lake approaches molecular exchange. During other periods of direct stratification, vertical exchange is approximately of the order of 1-2 times higher than molecular exchange. Similarity in vertical distribution of water and in hydrochemical and hydrobiological indices in Lake Gek-Ge' and the Black Sea may be due to similar conditions of vertical exchange in the two bodies of water, although in Lake Gek-Ge' the rate of vertical exchange during the period of sharp stratification is of an order lower than in the Black Sea. Data are presented on the best studied ectogenic, crenogenic, and biogenic meromictic lakes of the world. (See also W74-09100) (Josefson-USGS)  
W74-09108

**A COMPARATIVE ESTIMATE OF ENERGY LOSSES IN WATER BODIES AND IN TRANQUIL AND TURBULENT FLOWS (SRAVNITEL'NAYA OTSENKA POTER' ENERGIY V VODOYEMAKH, SPOKOYNYKH I BURNYKH POTOKAKH),** Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).

V. A. Znamenskiy.

In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyi Gidrologicheskii Institut Trudy, No 203, p 186-199, Leningrad, 1973. 3 fig, 1 tab, 8 ref.

Descriptors: \*Subcritical flow, \*Turbulent flow, \*Bodies of water, \*Energy loss, \*Estimating, Fluid mechanics, Hydraulics, Hydraulic gradient, Slopes, Reynolds number, Froude number, Velocity, Viscosity, Turbulence, Chezy equation, Roughness(Hydraulic), Friction, Resistance, Chutes, Bottom sediments.  
Identifiers: \*USSR.

Problems in estimation of energy losses for different types of flows are considered. Basic indicators are hydraulic gradient, Reynolds and Froude criteria, and relative smoothness of the bottom surface. Analytical expressions are obtained for determining total energy losses and coefficients of

hydraulic friction in water bodies and chutes, where bottom roughness is a static phenomenon. The analytical relations proposed agree with conclusions from Prandtl's semiempirical theory and with results of experimental investigations of kinematic characteristics of the bottom layer. Relations proposed for flows in water bodies can be used to determine mean velocity and coefficients of turbulent exchange. (See also W74-09100) (Josefson-USGS)  
W74-09109

**STATISTICAL AND SPECTRUM ANALYSES OF WIND WAVES ON THE KAYRAKKUM RESERVOIR (STATISTICHESKIY I SPECTRAL'NYY ANALIZY VETROVOGO VOLNENIYA NA KAYRAKKUMSKOM VODOKHRANILISHCHE).**  
Gosudarstvennyy Gidrologicheskii Institut, Leningrad (USSR).  
M. I. Krivoshey, and R. B. Kudryashova.  
In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyy Gidrologicheskii Institut Trudy, No 203, p 200-222, Leningrad, 1973. 8 fig, 2 tab, 16 ref.

Descriptors: \*Reservoirs, \*Waves(Water), \*Statistical methods, Correlation analysis, Probability, Wind velocity, Winds, Fetch, Curves, Equations.  
Identifiers: \*USSR(Kayrakkum Reservoir), \*Wind waves, \*Spectrum analysis, Pearson distributions, Correlograms.

The Kayrakkum Reservoir, located in the western part of the Fergana valley on the Syr Dar'ya River, was built in 1956. The area of the reservoir is 523 sq km; length is 56 km; maximum width is 15 km; mean depth is 8 m; and maximum depth near the dam is 20-24 m. Statistical and spectrum analyses were made of several recordings of steady wind waves and an analysis was also made of the errors of computation of mean wave heights and periods in deep water of the reservoir. Distribution curves of wave heights and periods conform fairly good to the Pearson Type 1 distribution. Rayleigh's curve, developed under the assumption of a normal law of distribution of wave ordinates, agrees poorly with empirical data. At wind velocities of 10-15 m/sec the relative error of computation of mean wave heights after the Bratslavskiy and spectral methods is practically the same and equals 5%. At a wind velocity of 5 m/sec both methods overestimate wave heights, the Bratslavskiy method by 24% and the spectral method by 38%. At a wind velocity of 5 m/sec the Labzovskiy method overestimates wave heights by 68%. At a wind velocity of 10-12 m/sec the error of computation is zero and at a wind velocity of 15 m/sec it is 17%. (See also W74-09100) (Josefson-USGS)  
W74-09110

**VOLUME OF WATER IN RIVERS, LAKES, AND RESERVOIRS OF THE SOVIET UNION (OB'YEM VODY V REKAKH, OZERAKH I VODOKHRANILISHCHAKH SOVETSKOGO SOYUZA).**  
Gosudarstvennyy Gidrologicheskii Institut, Leningrad (USSR).  
R. A. Nezhikovsky.  
In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyy Gidrologicheskii Institut Trudy, No 203, p 239-247, Leningrad, 1973. 1 fig, 6 tab, 10 ref.

Descriptors: \*Water, \*Rivers, \*Lakes, \*Reservoirs, \*Volume, Discharge(Water), Equations.  
Identifiers: \*USSR.

The number of rivers in the Soviet Union is 2,963,397, and their total length is 9,647,864 km. The total volume of water in the rivers is 504 cu km. The number of lakes in the country is 2,854,157, and their total water surface area is 521,644 sq km. Of the total volume of water

(27,994 cu km) in lakes, 23,000 cu km or almost 82% is concentrated in Lake Baykal. The volume of water in the three largest lakes of the country (Baykal, Issyk-Kul' and Aral Sea) is 25,750 cu km or 92% of all of the country's lake water. The number of river reservoirs with a total storage of 0.001 cu km or more is 747, and the total volume of water in these reservoirs is 598 cu km. The volume of water in river reservoirs with a normal backwater level is 603 cu km. The total volume of water in all water bodies of the country is 29,101 cu km or almost 7 times the volume of annual runoff into seas, oceans, and enclosed lakes during an average water year (4,384 cu km). Water in rivers is completely renewed 8.7 times a year, i.e., every 42 days. Water in lakes and reservoirs (excluding Lake Baykal and, correspondingly, runoff of the Angara River) is renewed once every 1.3 years. Considering the land area of the Soviet Union (22,272,000 sq km) the total volume of water in water bodies corresponds to a uniform water depth of 1,300 mm, which is 6.6 times the depth of runoff (198 mm) and 2.5 times the depth of atmospheric precipitation (531 mm). (See also W74-09100) (Josefson-USGS)  
W74-09111

**WATER BALANCE OF WORLD LAKES AND RESERVOIRS (VODNYI BALANS OZER I VODOKHRANILISHCH ZEMNOGO SHARA).**  
Gosudarstvennyy Gidrologicheskii Institut, Leningrad (USSR).  
Z. A. Vikulina.  
In: Voprosy rezhima i issledovaniya ozer i vodokhranilishch; Gosudarstvennyy Gidrologicheskii Institut Trudy, No 203, p 248-262, Leningrad, 1973. 4 tab, 12 ref.

Descriptors: \*Lakes, \*Reservoirs, \*Water balance, \*Hydrologic cycle, Inflow, Precipitation(Atmospheric), Discharge(Water), Runoff, Evaporation, Water level fluctuations, Geographical regions, North America, Europe, Asia, Africa.  
Identifiers: \*USSR.

Quantitative estimates are made of the volumes of water which contribute to the hydrologic cycle of major and some moderate-size and small lakes and reservoirs in North America, Europe, Asia, and Africa. The volume of water participating in the hydrologic cycle of major lakes in North America is 440 cu km, in Europe—126 cu km, in Asia—172 cu km, and in Africa—153 cu km. The proportion of major incoming components—surface inflow and precipitation—in the water balance of lakes in North America is 55% and 45%, respectively; in Europe—80% and 20%, in Asia—83% and 17%, and in Africa—30% and 70%. The proportion of major outgoing components—runoff and evaporation—in the water balance of lakes in North America is 62% and 38%, respectively, in Europe—86% and 14%, in Asia—39% and 61%, and in Africa—32% and 68%. In areas of intense economic exploitation the total hydrologic cycle increases at the expense of large reservoirs. The volume of water participating in the water balance of Volga River reservoirs is 240 cu km or approximately twice the hydrologic cycle of large lakes of Europe. The results obtained represent the first stage in the study of the hydrologic cycle of lake waters of the world. Additional water-balance studies should include new bodies of water such as large lakes and reservoirs in South America, Australia, and Southeast Asia and should be extended to moderate-size lakes in different climatic zones of the world. (See also W74-09100) (Josefson-USGS)  
W74-09112

**GREAT LAKES RESEARCH PROJECT FORECASTS DIRECTORY 1973.**  
National Ocean Survey, Detroit, Mich. Lake Survey Center.  
L. X. Barbalas.  
Technical Memorandum NOS LSC D 5, April 1973. 280 p.

Descriptors: \*Great Lakes, \*Research and development, Great Lakes Region, \*Limnology, \*Meteorology, Research facilities, Sedimentology, Data collections, Environment.  
Identifiers: \*Directories.

The directory of research in the Great Lakes describes over 270 proposed, continuing, and completed research and development projects, technical reports, theses, and data surveys during 1973. Seven indexes are provided, as follows: (1) Organizational; (2) Geographical; (3) Subject field; (4) Procedures and services; (5) Mode of investigation; (6) Platforms and equipment; and (7) Principal investigators. (Knapp-USGS)  
W74-09118

**EFFECT OF ENVIRONMENTAL FACTORS ON LAKE ZOOBENTHOS IN THE SOUTHERN PART OF WESTERN SIBERIA (IN RUSSIAN).**  
Novosibirsk Siberian Research Inst. of the Fish Industry (USSR).  
For primary bibliographic entry see Field 5C.  
W74-09120

**BIOCOENOSSES OF THE PALUSTRINE BODIES OF WATER OF THE SOUTHERN PART OF THE LAKE ONEGA-WHITE SEA WATERSHED. (IN RUSSIAN).**  
For primary bibliographic entry see Field 5C.  
W74-09127

**FORMATION OF GAS CONDITIONS IN THE VILYUI RESERVOIR. (IN RUSSIAN).**  
Akademiya Nauk SSSR, Yakutsk. Institut Biologii.  
For primary bibliographic entry see Field 5C.  
W74-09162

**PHYSICAL TRANSPORT OF TRACE METALS IN THE LAKE WASHINGTON WATERSHED.**  
Washington Univ., Seattle.  
For primary bibliographic entry see Field 5B.  
W74-09210

**ICE THRUST ON SHORES OF NORTH GERMAN LAKES AND ITS EFFECT.**  
For primary bibliographic entry see Field 2C.  
W74-09219

**SURVEY OF LAKE FLOODING FROM ERTS-1: LAKE CHAMPLAIN.**  
Vermont Univ., Burlington. Dept. of Geography.  
Available from NTIS, Springfield, Va. 22151 as N73-27247 - Price \$3.00 printed copy; \$1.45 microfiche. Remote Sensing Laboratory Contract Report, June 1973. 9 p. 6 fig. NASA Contract NAS 5-21753.

Descriptors: \*Lakes, \*Water level fluctuations, \*New York, \*Floods, \*Remote sensing, Satellites(Artificial), Mapping.  
Identifiers: \*ERTS, \*Lake Champlain(NY).

ERTS-1 imagery showing seasonal lake-level conditions in Lake Champlain can be used to assess shoreline change and flooding extent. MSS bands 6 and 7 provide maximum land-water contrasts and are the most useful for shoreline location. Shoreline changes observed between ERTS coverages of October 10 (low water) and April 7 and 25 (high water) are readily apparent; enlargement of specific scenes by 4X provides data which can be transferred to a map base. The synoptic view provided by ERTS-1 makes it possible to map shoreline positions occurring at a specific lake stage. (Knapp-USGS)  
W74-09231

## Field 2—WATER CYCLE

### Group 21—Water In Plants

#### 21. Water In Plants

**LABORATORY CULTURE, GROWTH RATE, AND FEEDING BEHAVIOR OF A PLANKTONIC MARINE COPEPOD,**  
California Univ., San Diego, La Jolla. Inst. of Marine Resources.  
M. M. Mullin, and E. R. Brooks.  
Limnology and Oceanography, Vol 12, p 657-666, 1967. 2 fig, 3 tab, 29 ref.

Descriptors: \*Copepods, Ecology, \*Animal populations, \*Growth rates, Breeding, Marine algae, Saline water, Plankton, Cultures, Diatoms.  
Identifiers: \*Rhincalanus nasutus, \*Artemia salina.

Rhincalanus nasutus was cultured through seven consecutive generations in 19-liter carboys when provided with a mixture of diatoms and Artemia salina nauplii as food. The mean generation length was 8.7 weeks, similar to that of the local field population of this species during some seasons. Fecundity of laboratory-reared animals was lower than that of the field population. Instantaneous coefficients of individual exponential growth ( $k$  in the expression,  $W_t = W_0 e^{kt}$ , where  $W$  is body weight of organic carbon and  $t$  is days) were 0.24 to 0.12/day, depending on the age of the individual. About 10  $\mu$ g of detrital carbon were produced as exuviae during the growth of an individual. Even young nauplii fed preferentially on large food particles. The suggestion that the copepods' first antennae are used in the feeding process was not supported by an experimental test. *R. nasutus* nauplii are apparently active enough to avoid being eaten by their parents.  
W74-08732

**CULTURE STUDIES OF MARINE ALGAE. I. EISENIA ARBOREA,**  
G. J. Hollenberg.  
American Journal of Botany, Vol 26, p 34-41, January 1939.

Descriptors: \*Marine algae, \*Life cycles, \*Cytological studies.  
Identifiers: \*Eisenia arborea, Gametophyte plants, Laminariales.

A cytological investigation was made of critical stages in the life cycle of *Eisenia arborea*. The life cycle and the gametophyte plants of *Eisenia arborea* are essentially like those described for other members of the Laminariales.  
W74-08733

**THE DEVELOPMENT OF ARTIFICIAL MEDIA FOR MARINE ALGAE,**  
Haskins Labs., New York; and Marine Biological Station, Millport (Scotland).  
L. Provasoli, J. J. A. McLaughlin, and M. R. Droop.  
Archiv für Mikrobiologie, Bd 25, p 392-428, 1957.

Descriptors: \*Marine algae, \*Cultures, Water chemistry, \*Reviews.  
Identifiers: The development of culture media for marine algae is traced from the time of Miquel (1890) to the present. The principles involved in designing synthetic media suitable for bacteria-free cultures of a variety of exacting organisms are discussed and an account given of their application in the United States and United Kingdom.  
W74-08734

**REMATING IN A PLANKTONIC MARINE CALANOID COPEPOD,**  
Naval Research Lab., Washington, D.C.  
D. F. Wilson, and K. K. Parrish.  
Marine Biology, Vol 9, p 202-204, 1971.

Descriptors: \*Copepods, \*Plankton, Cultures, Productivity, \*Breeding.  
Identifiers: \*Acartia tonsa, \*Remating.

The knowledge that the initial mating in planktonic copepods may be inadequate to permit realization of a female's total reproductive potential, and that remating can occur, has important implications for both population dynamics and speciation studies. *Acartia tonsa* Dana females in controlled laboratory experiments were successfully remated after becoming totally infertile following approximately 3 weeks of highly fertile production. Large numbers of viable nauplii resulted from these second matings.  
W74-08735

**CULTURE OF A PLANKTONIC CALANOID COPEPOD THROUGH MULTIPLE GENERATIONS,**  
Naval Research Lab., Chesapeake Beach, Md.  
E. J. Zillioux, and D. F. Wilson.  
Science No. 151 (3713), p 996-998, 1966 (illus).

Descriptors: \*Growth rates, \*Cultures, \*Copepods, Productivity, \*Reproduction.  
Identifiers: \*Acartia tonsa.

*Acartia tonsa* has been propagated through 12 filial generations during 1 year in small laboratory cultures. The mean generation time was 25 days at 17 degrees C on a slightly suboptimum, mixed algal diet. Body size, reproductive capacity, and generation time were unchanged during the culture period.  
W74-08744

**REFLECTANCE, TRANSMITTANCE, AND ABSORPTANCE OF LIGHT BY SUBCELLULAR PARTICLES OF SPINACH (SPINACIA OLERACEA L.) LEAVES,**  
Agricultural Research Service, Weslaco, Tex.  
For primary bibliographic entry see Field 3F.  
W74-08809

**NATIVE INFUSORIA OF THE RIVER SVETUPE IN SUMMERTIME, (IN RUSSIAN),**  
Akademiya Nauk Latvinskoi SSR, Riga. Inst. of Biology.  
R. A. Liepa.  
Latv Psr Zinat Akad Vestis. 3, p 27-32, 1973. Illus. (English summary).  
Identifiers: Fauna, \*Infusoria, \*Protozoa, Rivers, Temperature, \*USSR (River Svetupe), Seasonal.

In the small river Svetupe (USSR) and in the estuaries of its tributaries (Perlupe, Arupe) the variety of free living protozoa appears to be insignificant. A total of 77 species of Protozoa were found: 56 in Svetupe, 28 in Perlupe and 17 in Arupe. The average number of Protozoa fluctuates from 90-160/sq. m, the maximum number 1020 thousand/sq. m, the minimum number 20 thousand/sq. m. The number of Protozoa depends on the temperature changes: the lowest number was observed in the second part of the month, when rapid lowering of the temperature occurred. The tributaries of the River Svetupe (Perlupe, Arupe), the hydrological structure and fauna of which greatly differ from that of the main stream, do not affect the structure and number of protozoa in the River Svetupe.--Copyright 1973, Biological Abstracts, Inc.  
W74-08925

**VASCULAR PLANTS OF WASTE STORAGE SITES IN THE 200 AREAS OF THE HANFORD RESERVATION,**  
Battelle-Pacific Northwest Lab., Richland, Wash.  
K. R. Price, and W. H. Rickard.  
Available from NTIS, Springfield, Va, as Rept No BNWL-1796; \$4.00/copy, \$1.45/microfiche. Report No BNWL-1796. December 1973, 7 p.

Descriptors: \*Radioactive waste disposal, \*Waste storage, \*Washington, \*Plant populations, \*Vascular tissues, Tracheids, Habits, Environment, Aquatic plants, Water pollution, Nuclear

powerplants. Speciation, Data collections, Ecosystems.  
Identifiers: \*Richland (Wash).

A brief account is presented of terrestrial, riparian and semi-aquatic plants known to be associated with radioactive waste storage sites in the 200 Areas of the Hanford Reservation. In most cases the species are characteristic of those which generally inhabit the reservation, but some plants are restricted to specialized habitats provided by particular waste storage sites. It is impractical to list all species growing at each waste storage site because of seasonal variation and changes brought about by environmental management practices. An alphabetical listing has been prepared with an example of where each species is known to occur. This list will be updated as needed and expanded to include other waste storage areas. Plant specimens were collected during spring and fall when flowering material was available. Herbarium mounts were prepared of many specimens and have been retained as part of the Hanford Reservation herbarium collection. Identification to species level was made whenever possible. (Houser-ORNL)  
W74-08967

**VERTICAL DIFFERENTIATION OF TIEN-SHAN TORRENTS, BASED ON THE DISTRIBUTION OF CHARACTERISTICS OF WATER INSECTS, (IN RUSSIAN),**  
Akademiya Nauk SSR, Leningrad. Zoologicheskii Institut.  
K. A. Brodskii, and E. O. Omorov.  
Gidrobiol Zh. Vol 9 No 2 p 40-51, 1973. Illus. (English summary).  
Identifiers: Ameletus-Alexandreae, Asioreas-Nivia, Asioreas-Tianschanica, Asioreas-Turkestanica, Blepharocera-Asiatica, \*Distribution patterns, Ecological factors, Iron-Montanus, Iron-Rheophilus, Rhithrogena-Tianschanica, Tianschanella-Monstrudsa, \*USSR (Tien-Shan), \*Aquatic insects.

An ecological-faunistic vertical differentiation of the mountain torrents in Tien-Shan (USSR) is presented. It is based on the occurrence of guide water insects (Ephemeroptera, Trichoptera and Diptera-Blepharoceridae). Two torrents in N and S Tien-Shan were subjected to a detail study; more than 60 were studied in general. The scheme is of rather universal significance and may be successively applied to Karakorum, Hindu-Kush and Himalaya mountain countries. Due to their faunas, the following zones are distinguished within Tien-Shan range: zone of glacier springs, zone of upper, middle and lower flow currents. Comparisons with schemes for Europe and North America show that Tien-Shan differs from them in specific peculiarities, making it possible to distinguish this distinct type of torrent for mountain countries of Asia. The most characteristic water insect guide species are endemics for Tien-Shan, Pamirs and adjoining mountain regions (Iron mountain, I. rheophilus, Rhithrogena tianschanica, Ameletus alexandreae, Tianschanella monstrosa, Blepharocera asiatica, Asioreas nivia, A. tianschanica, A. turkestanica, etc.).--Copyright 1973, Biological Abstracts, Inc.  
W74-09063

**EFFECTS OF VARIOUS WATER REGIMES ON STOMATAL AND MESOPHYLL CONDUCTANCES OF BEAN LEAVES,**  
Akademiya Nauk Estonskoi SSR, Tartu. Institut Fiziki i Astronomii.  
For primary bibliographic entry see Field 3F.  
W74-09247

#### 2J. Erosion and Sedimentation

**LACUSTRINE SALT DEPOSITS UNDER PRESENT-DAY SEDIMENTS OF THE ARAL SEA (SOLYANYE OZERNYYE OTLOZ-**

**HENIYA POD SOVREMENNYMI OSADKAMI ARAL'SKOGO MORYA),**  
Akademiya Nauk Uzezkoi SSR, Tashkent. Institut Geologii i Geofiziki.  
For primary bibliographic entry see Field 2H.  
W74-08712

**LIGHTING UP THE HAZE OF TURBIDITY MEASUREMENT.**  
For primary bibliographic entry see Field 7B.  
W74-08912

**TURBIDIMETERS MONITOR DUBAI FLOOD WATER.**  
For primary bibliographic entry see Field 7B.  
W74-08913

**DISTRIBUTION OF SELECTED TRACE METALS IN SOUTHERN LAKE MICHIGAN AND LOWER GREEN BAY,**  
Illinois Univ., Urbana. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5B.  
W74-08934

**LABORATORY SIMULATION OF RAINFALL EROSION FOR GULLY FORMATION STUDY,**  
Kentucky Univ., Lexington. Water Resources Research Inst.  
T. Y. Kao.  
Available from the National Technical Information Service as PB-232 999; \$3.75 in paper copy, \$1.45 in microfiche. Research Report No 73, May 1974. 61 p., 23 fig., 4 tab., 21 ref. OWRR A-037-KY(1). 14-31-0001-3517 and 14-31-0001-3817.

Descriptors: \*Simulated rainfall, \*Gully erosion, \*Rainfall simulators, \*Soil erosion, Kinetics, Energy, Simulation analysis.  
Identifiers: Water drops, Momentum, Erosivity index.

The objective was to develop a rainfall simulator, which imparts to the laboratory rainfall the more important characteristics of natural rainfall such as intensity, drop spectrum, kinetic energy, and momentum at impact, for using in soil erosion research with better results. In developing this simulator the better features of the basic types of earlier simulators, drip and nozzle, have been incorporated into this single design. The simulator developed in this study consists of a number of individual box modules placed in a rectangular pattern to form a single unit. Each module has a grid of capillary holes with cone shaped exits drilled through the bottom plate. The modules were mounted so that their bottom plates form the ceiling of a pressurized room. This provides a hydrostatic pressure differential between the bottom plate and the water surface in each module, such that water will not leak through the holes during the nonoperating state. When pressure pulses are applied to the water surface in each module, water drops are ejected with an initial velocity so that a terminal velocity corresponding to a natural rain drop can be attained without requiring excessive height of fall. The test results indicated that this simulator provides good simulation of the natural rainfall erosivity. (Grieves-Kentucky)  
W74-08937

**SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, TAOS COUNTY,**  
New Mexico State Univ., University Park. Dept. of Agronomy.  
For primary bibliographic entry see Field 3F.  
W74-09054

**PROTOCOL FOR EVALUATING THE NITROGEN STATUS OF LAKE SEDIMENTS,**  
Wisconsin Univ., Madison. Dept. of Soil Science.  
For primary bibliographic entry see Field 5C.  
W74-09065

**A. BACTERIAL METHYLMERCURY-MINERALIZING ACTIVITY IN RIVER SEDIMENTS,**  
Brussels Univ. (Belgium). Laboratorium voor Ekologie en Systematiek.  
For primary bibliographic entry see Field 5B.  
W74-09092

**SEDIMENT DISTRIBUTION AND EVOLUTION OF TIDAL DELTAS ALONG A TIDE-DOMINATED SHORELINE, WACHAPREAGUE, VIRGINIA,**  
Texas Univ., Austin. Bureau of Economic Geology.  
For primary bibliographic entry see Field 2L.  
W74-09099

**SEDIMENT DISCHARGE IN THE TRINITY RIVER BASIN, CALIFORNIA,**  
Geological Survey, Menlo Park, Calif.  
J. M. Knott.  
Water-Resources Investigations 49-73, April 1974. 56 p., 17 fig., 8 tab., 29 ref.

Descriptors: \*Sediment discharge, \*Sediment transport, \*California, Bed load, Suspended load, Sediment yield, Floods, Channel morphology.  
Identifiers: \*Trinity River basin(Calif).

Long-term total-sediment discharge of the Trinity River, California, and selected tributaries is estimated. Water-discharge data for the period 1912-70 and sediment data collected between 1955 and 1970 were used to evaluate trends and relations between sediment discharge (suspended and bedload) and water discharge. The hydraulic and sediment-transport characteristics of many of the streams in the basin were significantly altered by the December 1964 flood. The depth and velocity of streams changed drastically; for equal magnitudes of streamflow, suspended-sediment discharges after the 1964 flood were several times larger than before the flood. The long-term average annual sediment discharge of the Trinity River near Hoopa is estimated to be 3,120,000 tons. The percentage of clay, silt, and sand or coarser material at this station is estimated to be 20, 32, and 48 percent. Bedload discharge is estimated to be 19 percent of the total-sediment discharge. (Knapp-USGS)  
W74-09225

## 2K. Chemical Processes

**CALCIUM-MAGNESIUM-POTASSIUM EQUILIBRIA IN SOME CALIFORNIA SOILS,**  
California Univ., Davis. Dept. of Pomology.  
For primary bibliographic entry see Field 2G.  
W74-08814

**FURTHER EVIDENCE FOR THE INABILITY OF THE KJELDAHL TOTAL NITROGEN METHOD TO FULLY MEASURE INDIGENOUS FIXED AMMONIUM NITROGEN IN SUBSOILS,**  
Nebraska Univ., Lincoln. Agricultural Experiment Station.  
For primary bibliographic entry see Field 2G.  
W74-08819

**FLUID SAMPLE ANALYSIS SYSTEM,**  
Durrum Development Corp., Palo Alto, Calif. (assignee)  
For primary bibliographic entry see Field 7B.  
W74-08914

**INTERACTING DIFFUSE LAYERS IN MIXED MONO-DIVALENT IONIC SYSTEMS,**  
Volcani Inst. of Agricultural Research, Bet Dagan (Israel).  
For primary bibliographic entry see Field 2G.  
W74-08920

**INVESTIGATION OF THE CHEMICAL IDENTITY OF SOLUBLE ORGANOPHOSPHORUS COMPOUNDS FOUND IN NATURAL WATERS,**  
Illinois Inst. of Tech., Chicago. Dept. of Environmental Engineering.  
For primary bibliographic entry see Field 5A.  
W74-08935

**CHEMISTRY IN THE EXPLORATION AND EXPLOITATION OF HYDROTHERMAL SYSTEMS,**  
Department of Scientific and Industrial Research, Wellington (New Zealand). Chemistry Div.  
W. A. J. Mahon.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1310-1322, 1973, 3 fig., 2 tab., 17 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, \*Water chemistry, Exploration, Heat flow, Thermal water, Mineral water, Boreholes, Thermal springs, Sampling.  
Identifiers: \*Borehole geochemistry, New Zealand, Geothermal power.

Geochemistry plays an important role in the investigation of hydrothermal systems. Experimental information on the geochemistry of individual elements in high temperature environments, and thermodynamic data for solution equilibria and gas solubilities has enabled detailed interpretations to be made of natural hot water and steam compositions. The lateral extent and chemical uniformity of the deep system can often be judged, and zones of high rock permeability connecting the aquifer at depth to the surface outlined. Minimum estimates of the deep water temperature may be made from the concentration of constituents such as silica, magnesium, and fluoride, and from the ratio of sodium to potassium in the spring waters. The tendency for deposition of minerals, particularly calcite, in the deep aquifer during exploitation, can sometimes be assessed from the carbon dioxide and ion concentrations in the surface flows. Information on rock types in the deep system may be obtained from the surface water chemistry. The chemistry of fluids discharged from drillholes during exploration and production drilling provides information on the temperature of the water supplying the drillholes, the migration of fluids and the distribution of steam and water in the system, changes in temperatures and pressures in the aquifer during exploitation, and the possibility of minerals depositing. Examples are given of interpretations of this type from the New Zealand hydrothermal areas of Wairakei, Broadlands, Waiotapu, Orakeikorako, and Ngawha. (See also W74-08973) (Knapp-USGS)  
W74-09013

**ORIGIN OF THERMAL WATERS ON THE BASIS OF THEIR RADIOISOTOPIC CONTENT,**  
Akademiya Nauk SSSR, Moscow. Geologicheskii Institut.  
V. V. Cherdyn'tsev.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1340-1343, 1973, 3 tab., 5 ref.

Descriptors: \*Geochemistry, \*Radioisotopes, \*Geothermal studies, \*Hydrothermal studies, Volcanoes, Thermal water, Mineral water, Exploration, Thermal springs.  
Identifiers: \*USSR, Geothermal power.

The contents of the isotopes of U, Ra, Th, Rn, Ac, and Pb were investigated in waters of active volcanism (Kamchatka, Kuril Islands) and in thermal waters of neovolcanic regions (Caucasus), USSR. The content of radioisotopes in the condensates of the volcanic vapors is very like that of the depth gases. (See also W74-08973) (Knapp-USGS)  
W74-09015

## Field 2—WATER CYCLE

### Group 2K—Chemical Processes

#### THE COLLECTION AND ANALYSIS OF VOLCANIC AND HYDROTHERMAL GASES,

Department of Scientific and Industrial Research, Taupo (New Zealand). Chemistry Div. J. B. Finlayson.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1344-1354, 1973, 7 fig, 1 tab, 45 ref.

Descriptors: \*Sampling, \*Geochemistry, \*Water chemistry, \*Thermal water, \*Hydrothermal studies, Gases, Geothermal studies, Water analysis, Volcanoes, Radioisotopes.

Identifiers: \*Hydrothermal gases, New Zealand, Geothermal power.

A knowledge of the composition of the gas phase associated with the various surface emanations of volcanic and geothermal systems forms an essential part of the study of these systems. Gases play a major role in eruptive phenomena, such as lava fountains and volcanic explosions, and may be useful in predicting eruptions. The interpretation of the composition of gases emitted from fumaroles, hot springs and drillholes in a geothermal field gives a better understanding of the underlying hot water aquifer. A survey of the literature since the beginning of this century shows that five basic methods have been employed for taking gas samples: displacement of air from the sample container, displacement of water or mercury, vacuum tubes or flasks, condensation and absorption. Specific examples are given of the application of these methods either singly or in combination. The advantages and disadvantages of these techniques are discussed, particularly with respect to their success in meeting requirements for the collection of a gas sample. Specific examples of methods used for the analysis of gas samples are discussed. The techniques include absorption methods, wet chemical methods both titrimetric and gravimetric, and instrumental methods (spectroscopy, mass spectrometry and gas chromatography). Possible ways to improve collecting techniques are discussed and the possible application of some more recent instrumental methods of analysis are suggested. (See also W74-08973) (Knapp-USGS) W74-09016

#### INTERPRETATION OF GAS COMPOSITIONS FROM THE WAIRAKEI FIELD OVER 10 YEARS,

Department of Scientific and Industrial Research, Taupo (New Zealand). Chemistry Div. R. B. Glover.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1355-1366, 1973, 9 fig, 4 tab, 13 ref.

Descriptors: \*Sampling, \*Geochemistry, \*Water chemistry, \*Thermal water, \*Hydrothermal studies, Gases, Geothermal studies, Water analysis, Volcanoes, Radioisotopes.

Identifiers: \*Hydrothermal gases, \*New Zealand, Geothermal power.

From 1959 to 1969 15 systematic surveys of the carbon dioxide and hydrogen sulphide content of the Wairakei geothermal drillhole discharges were made. Gas solubility data were used to calculate theoretical curves relating the percentage steam separation from the original water to the carbon dioxide content, hydrogen sulphide content, and the carbon dioxide/hydrogen sulphide ratio in both the separated steam and the residual water. From a comparison of the actual gas concentrations of drillhole discharges with the theoretical curves, it was possible to deduce the underground separation and mixing processes taking place and to follow changes in downhole pressures and temperatures. Either nonequilibrium gas and steam separation takes place or steam separation occurs in several stages during the movement of the

geothermal fluid. Evidence from downhole temperatures measured under nondischarging conditions, the supply water temperatures during discharge calculated from silica concentrations, and enthalpy data suggest that many drillholes are discharging water which has lost steam at some distance from the drillholes. (See also W74-08973) (Knapp-USGS) W74-09017

#### HIGH ACTIVITY HYDROTHERMAL ZONES DETECTED BY Na/K, CERRO PRIETO, MEXICO,

Comision Federal de Electricidad, Mexico City. Geothermochemical Research. S. Mercado.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1367-1376, 1973, 10 fig, 1 tab, 20 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, Water chemistry, Exploration, Heat flow, Thermal water, Mineral water, Boreholes, Thermal springs, Sampling, \*Mexico.

Identifiers: \*Borehole geochemistry, Geothermal power.

The chemical index or molar ratio Na/K is a good indicator of high hydrothermal activity zones in the Cerro Prieto geothermal field, Mexico. Drillholes with a Na/K ratio of 6 have bottom temperatures of 370 deg C and 70 kg/sq cm of pressure at the wellhead, and drillholes with high Na/K proportion (16) have only 160 deg C at the bottom and 3 kg/sq cm of pressure at the wellhead. The Na/K ratio is indicative of the high steam production zones and helps to determine the underground water distribution and migration with acceptable results. (See also W74-08973) (Knapp-USGS) W74-09018

#### CHEMICAL STUDIES IN MEXICAN GEOTHERMAL FIELDS,

Comision Federal de Electricidad, Mexico City. Inst. of Investigations of Electrical Industry. B. R. Molina, and C. J. Banwell.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1377-1391, 1973, 4 fig, 9 tab, 8 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, \*Water chemistry, Exploration, Heat flow, Thermal water, Mineral water, Boreholes, Thermal springs, Sampling, \*Mexico.

Identifiers: \*Borehole Geochemistry, Geothermal power.

Chemical samples have been analyzed from the geothermal fields of Los Humeros, Ixtlan de los Hervores, Los Negritos, Pathe, and Cerro Prieto, all in Mexico. Quantitative analyses for up to 16 principal elements or compounds were made on water samples as well as from selected hot springs, and steam and gas discharges were analyzed for seven gaseous elements and compounds. In Los Humeros, where the manifestations consist only of dry steam vents, water analyses were made on condensate, but in the other areas the analyses were made on samples from hot springs, geysers, and mud pools. In Ixtlan de los Hervores, water samples were also available from two test drillholes. Samples were taken from a large enough number of points to permit isochemical contours of several kinds to be drawn in each area, and the resulting patterns show a striking correlation with certain of the geological and geophysical data. These correlations have been of considerable value for siting prospecting drillholes in the Ixtlan area. A number of the more important chemical relationships were plotted in the conventional type

of triangle or other form of diagram and compared with similar data from fields in other parts of the world. (See also W74-08973) (Knapp-USGS) W74-09019

#### GEOCHEMISTRY OF THE AHUACHAPAN THERMAL AREA, EL SALVADOR, CENTRAL AMERICA,

Iceland Univ., Reykjavik. Science Inst. G. E. Sigvaldason, and G. Cuellar.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1392-1399, 1973, 1 fig, 4 tab, 11 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, \*Water chemistry, Exploration, Heat flow, Thermal water, Mineral water, Boreholes, Thermal springs, Sampling, Identifiers: \*El Salvador.

Geothermal activity in El Salvador consists of two types of thermal areas: Low temperature areas with hot spring activity, and high temperature areas also displaying fumarolic activity. The high temperature area at Ahuachapan is being studied at present, and deep drilling has started. Two distinct chemical types of thermal water exist in the area: a shallow aquifer with a moderate concentration of dissolved solids (temp. 120-150 deg C) and a deep aquifer with saline water (temp. at least 228 deg C). The shallow aquifer probably represents a normal groundwater body which is heated by escaping steam and water from the lower aquifer, and by conduction. Deuterium analyses of both types of thermal water show similar values to those found in cold water springs in the area, indicating common meteoric origin. (See also W74-08973) (Knapp-USGS) W74-09020

#### A NOTE ON THE HOT SPRINGS OF ECUADOR,

Proyecto Minero, Quito (Ecuador). A. De Grys, J. Vera, and P. Goossens.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1400-1404, 1973, 1 fig, 3 tab, 18 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, \*Water chemistry, Exploration, Heat flow, Thermal water, Mineral waters, Boreholes, Thermal springs, Sampling, Identifiers: \*Ecuador.

Waters from several Ecuadorian hot springs were analyzed. The springs may be divided into three groups: (a) coastal springs; (b) a northern group of springs which are in the vicinity of volcanoes; and (c) a southern group of springs associated with travertine deposits, situated in an area of Pliocene-Pleistocene volcanism. The last group has waters with high concentrations of Ca HCO<sub>3</sub>, Na, and Cl, besides adnormal amounts of Li, As, and B; the SO<sub>4</sub> content is low. There may be a relationship between these waters and the numerous epithermal deposits in the area. (See also W74-08973) (Knapp-USGS) W74-09021

#### DEUTERIUM AND CHLORIDE IN GEOTHERMAL STUDIES IN ICELAND,

Iceland Univ., Reykjavik. Science Inst. B. Arnason, and J. Tomasson.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1405-1415, 1973, 6 fig, 6 tab, 12 ref.

Descriptors: \*Thermal water, \*Hydrothermal studies, \*Deuterium, \*Chlorides, Groundwater

movement, Hydrogeology, Water chemistry, Tracers.  
Identifiers: \*Iceland, Geothermal power.

In Iceland, deuterium measurements are useful for distinguishing between different water systems, even in the same geothermal field. One of the areas is fed by at least three hot-water systems of different origin. Two other areas are fed by two hotwater systems each. Deuterium measurements used together with chemical analyses of the water may give valuable information about the chemical composition of the geological formations through which the groundwater flows and about the chemical reactions taking place. In some cases the groundwater, initially meteoric, has passed through chloride-rich formations in the ground whereby it acquires considerable amounts of chloride. In one place the hot-water originates in the ocean. The possibility that the deuterium concentration of the hot-water may change during its passage underground is discussed; on the basis of data available at present it is concluded that such a change does not take place. In one of the areas the hot groundwater contains less deuterium than the lowest yearly average value of precipitation found in Iceland at present. The explanation offered for this is that this water dates from a time when the climate was considerably colder than it is today. (See also W74-08973) (Knapp-USGS)  
W74-09022

#### CHEMICAL PROSPECTING OF STEAM AND HOT WATER IN THE MATSUKAWA GEOTHERMAL AREA,

Japan Metals and Chemicals Co., Ltd., Morioka, Y. Fujii, and T. Akeno.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1416-1421, 1973. 3 fig, 6 tab.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, \*Water chemistry, Exploration, Heat flow, Thermal water, Mineral water, Boreholes, Thermal springs, Sampling.  
Identifiers: \*Geothermal prospecting, \*Japan, Geothermal power.

In the Matsukawa geothermal area, Japan, the first experimental well, AR-1, was drilled in 1960, and the sixth production well, No. 6, was completed January, 1969. The steam of Matsukawa is classified into three types according to the physical characteristics such as the degree of moisture and existence of hot water. Chemically, it is classified in two types according to the composition of the steam. The shallower wells tend to contain more hydrogen sulfide. Drilling a new well did not cause any decrease of the steam amount in former wells. With regard to the discharge of hot water, however, interference was observed between No 1 and No 4 wells, and No 1 and No 5 wells. (See also W74-08973) (Knapp-USGS)  
W74-09023

#### GEOCHEMISTRY OF THE WATERS DISCHARGED FROM DRILLHOLES IN THE OTAKE AND HATCHOBARU AREAS,

Kyushu Univ., Beppu(Japan). Inst. of Balneotherapeutic Research I.  
A. Koga.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1422-1425, 1973. 3 tab.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, \*Water chemistry, Exploration, Heat flow, Thermal water, Mineral water, Boreholes, Thermal springs, Sampling.  
Identifiers: \*Geochemical prospecting, \*Japan, Geothermal power.

The waters discharged from drillholes at Otake and Hatchobaru geothermal areas in Japan are slightly alkaline and contain sodium and potassium chlorides as major constituents. Otake and Hatchobaru waters may be somewhat diluted with shallow waters rich in sulphate and bicarbonate. The water temperatures calculated were between 195 deg C and 240 deg C at Otake, and 300 deg C at Hatchobaru. In general, the deep waters at Otake and Hatchobaru, especially Hatchobaru water, may be considered typical of geothermal areas in Japan. (See also W74-08973) (Knapp-USGS)  
W74-09024

#### PHYSICO-CHEMICAL SAMPLING OF HIGH TEMPERATURE WELLS IN CONNECTION WITH THEIR ENCRUSTATION BY CALCIUM CARBONATE,

Adademiya Nauk SSSR, Novosibirsk. Institut Neorganicheskoi Khimii.  
For primary bibliographic entry see Field 4B.  
W74-09036

#### THERMAL WATERS AS A SOURCE FOR EXTRACTION OF CHEMICALS,

Akademiya Nauk SSSR, Moscow. Geologicheskii Institut.  
A. V. Shcherbakov, and V. I. Dvorov.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1636-1639, 1973. 2 fig, 5 ref.

Descriptors: \*Saline waters, \*Hydrothermal studies, \*Thermal water, Salts, Bromine, Chlorine, Iodine, Potassium, Lithium, Rubidium, Groundwater, Brines, Mineral water.  
Identifiers: \*USSR.

Thermal waters have become the focus of attention in recent years as a source of mineral reserves and energy, both in the Soviet Union and abroad. Chloride waters, rich in salts of bromine, potassium, lithium, and strontium are formed in halogen formations found throughout the sedimentary sequence. Concentration of bromine, strontium, lithium and rubidium increases with depth of occurrence of thermal waters and rising mineralization, while boron and iodine show a reverse dependence; their concentration goes down with depth and rising mineralization. (See also W74-08973) (Knapp-USGS)  
W74-09038

#### EXPLORATION OF THE REYKIANES THERMAL BRINE AREA,

National Energy Authority, Reykjavik (Iceland). S. Bjornsson, S. Arnorsson, and J. Tomasson.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1640-1650, 1973. 8 fig, 4 tab, 7 ref.

Descriptors: \*Brines, \*Water chemistry, \*Thermal water, Mineral water, Chlorides, Sodium, Potassium, Calcium, Hydrogeology, Hydrothermal studies.  
Identifiers: \*Iceland.

The Reykjanes thermal brine area is located in the extreme southwest of Iceland. This area is unique among thermal areas for its fluid composition. In the reservoir where temperatures are between 250 and 290 deg C, the brine has the same salinity as seawater. However, the concentrations of some ions are different and can be explained by relatively simple interaction of seawater with the rock. Due to its temperature and composition, feasibility studies indicate that the brine could be exploited economically for the production of NaCl, KCl, CaCl<sub>2</sub>, and possibly other components. Aquifers are abundant in the basalt formation. It is therefore recommended that production wells penetrate

to depths of about 2,600 m to withdraw brine within this permeable formation so as to ensure highest mass flow and minimize risk of cold sea-water intrusion. (See also W74-08973) (Knapp-USGS)  
W74-09039

#### CONTRIBUTION TO THE MINERAL EXTRACTION FROM SUPERSATURATED GEOTHERMAL BRINES, SALTON SEA AREA, CALIFORNIA,

H. H. Werner.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1651-1655, 1973. 2 fig, 4 tab.

Descriptors: \*Hydrothermal studies, \*Brines, \*California, \*Water chemistry, Mineral water, Thermal water, Zinc, Lead, Tin, Titanium, Copper, Silver, Gold, Beryllium, Scaling, Thermal power.  
Identifiers: \*Geothermal power, \*Salton Sea(Cal).

Mud volcanoes, pumice domes, and warm thermal springs are characteristic for the Salton Sea geothermal area in the northern part of the Imperial Valley, California. The recovery of Zn, Pb, Sn, Ti, Cu, Ag, Au and Be could amount to about \$264,670 per well per year. In some cases the value of the minerals can supersede the value derived from the sale of the power and will make the complete project viable. (See also W74-08973) (Knapp-USGS)  
W74-09040

#### GEOTHERMAL PRODUCTION OF ELECTRICAL ENERGY AND CERTAIN MINERALS,

Makerere Univ., Kampala (Uganda). Dept. of Physics.  
For primary bibliographic entry see Field 2F.  
W74-09041

## 2L. Estuaries

#### ECOLOGICAL EQUILIBRIUM OF RIVER-ESTUARY-SEA SYSTEMS AND IMPROVEMENT OF THEIR EFFICIENCY FOR THE NATIONAL ECONOMY (O EKOLOGICHESKOM RAVNOVESII SISTEM REKA-LIMAN-MORE I POVYSHENII IKH NARODNOKHOZYAYSTVENNOY EFFEKTIVNOSTI),

Akademiya Nauk URSS, Odessa. Institut Ekonomiki.  
M. T. Meleshkin, and M. Sh. Rozengurt.  
Vodnyye Resursy, No 4, p 68-82, 1973. 4 fig, 3 tab, 18 ref.

Descriptors: \*Balance of nature, \*Ecosystems, \*Saline water intrusion, \*Saline water-freshwater interfaces, \*Estuaries, Rivers, Oceans, Lagoons, Fish establishment, Fish populations, Fishkill, Human population, Systems analysis, Maps.  
Identifiers: \*USSR, \*Dniester River, \*Dnieper River, \*Danube River.

The possibility is examined of applying the systems approach to solution of the problem of transformation of natural conditions of the river-estuary-sea system under influence of human activity. The systems concept of a river-estuary-sea ecosystem can eventually be used to simulate processes occurring at the level of interaction of subsystems and to qualitatively evaluate the structural relations. The effects of man on natural conditions of the ecosystem are investigated, using, as an example, the Dniester River basin and the Dniester estuary. At the present stage of development of productive resources in the Southern Economic Region, the sole sources of water are runoff of the Danube (196 cu km), Dniester (8 cu km), Dnieper (51 cu km), and freshwaters of major open estuaries of the Dniester (volume—0.7 cu km) and

## Field 2—WATER CYCLE

### Group 2L—Estuaries

Dnieper (volume--3 cu km). Location of estuaries and estuarine lagoons in the northwestern part of the Black Sea is mapped. (Josefson-USGS)  
W74-08708

**THE SALINITY TOLERANCE OF SOME ESTUARINE PLANKTONIC COPEPODS,**  
Hull Univ. (England). Dept. of Zoology.  
For primary bibliographic entry see Field 5C.  
W74-08738

**EXPERIMENTAL STUDY OF EGG-LAYING IN THREE NERITIC COPEPOD SPECIES (CENTROPAGES TYPICUS, ACARTIA CLAUSI, AND TEMORA STYLIFERA).**  
Centre d'Océanographie, Marseille (France). Station Marine d'Endoume.  
R. Gaudy.  
Marine Biology, Vol 9, p 65-70, 1971.

Descriptors: \*Copepods, Life Cycles, Laboratory Animals, Phytoplankton, Algae, \*Fertility, Productivity.  
Identifiers: \*France(Gulf of Marseilles), \*Acartia clausi, \*Temora stylifera, \*Centropages typicus.

Egg-laying of 3 common copepod species from the Gulf of Marseilles (*Centropages typicus* Kroyer, *Acartia clausi* Giesbrecht, *Temora stylifera* Dana) has been studied under various trophic conditions, at different periods of the year. The role of phytoplankton abundance in the induction and importance of egg-laying is indicated. The specific quality of the algal suspension used for feeding affected also fertility. A seasonal variation in the importance of egg-laying is established. Some observations are made on egg deposition and development.  
W74-08741

**INVESTIGATION OF SURFACE FILMS - CHESAPEAKE BAY ENTRANCE,**  
Virginia Inst. of Marine Science, Gloucester Point.  
For primary bibliographic entry see Field 5A.  
W74-08831

**THE ROLE OF ORGANIC DEBRIS AND ASSOCIATED MICRO-ORGANISMS IN PELAGIC ESTUARINE FOOD CHAINS,**  
Maryland Univ., Solomons. Natural Resources Inst.  
For primary bibliographic entry see Field 5C.  
W74-08837

**SEDIMENTARY FLUORITE IN TAMPA BAY, FLORIDA,**  
University of South Florida, Tampa, Fla. Dept. of Geology.  
For primary bibliographic entry see Field 5A.  
W74-08970

**RADIOLOGICAL SURVEILLANCE AROUND TURKEY POINT, 1970-1971,**  
Florida State Div. of Health, Jacksonville. Radiological and Occupational Health Section.  
For primary bibliographic entry see Field 5A.  
W74-08970

**OPERATIONAL LEVELS OF ENVIRONMENTAL RADIOACTIVITY IN WATER AND SEDIMENT AROUND TURKEY POINT NUCLEAR POWER PLANTS, CARD SOUND, FLORIDA,**  
Florida Univ., Miami. School of Medicine.  
For primary bibliographic entry see Field 5A.  
W74-08971

**THE DEMOGRAPHIC, POLITICAL, AND ADMINISTRATIVE SETTING,**  
Florida Univ., Gainesville. Urban Studies Bureau.  
For primary bibliographic entry see Field 6B.

W74-09058

**HYDROGRAPHY AND BEACH DYNAMICS,**  
Rosenstiel School of Marine and Atmospheric Science, Miami, Fla.  
For primary bibliographic entry see Field 6B.  
W74-09059

**DEPOSITION OF DDE AND POLYCHLORINATED BIPHENYLS IN DATED SEDIMENTS OF THE SANTA BARBARA BASIN,**  
California Univ., Bodega Bay. Bodega Marine Lab.  
For primary bibliographic entry see Field 5B.  
W74-09097

**SEDIMENT DISTRIBUTION AND EVOLUTION OF TIDAL DELTAS ALONG A TIDE-DOMINATED SHORELINE, WACHAPREAGUE, VIRGINIA,**  
Texas Univ., Austin. Bureau of Economic Geology.  
R. A. Morton, and A. C. Donaldson.  
Sedimentary Geology, Vol 10, No 4, p 285-299, December 1973. 7 fig, 21 ref.

Descriptors: \*Sedimentation, \*Shores, \*Tidal effects, \*Littoral drift, Deltas, \*Virginia, Beaches, Barrier islands, Geomorphology.  
Identifiers: \*Wachapreague(Va).

Major inlets in the vicinity of Wachapreague, Virginia have been relatively stable throughout Holocene time; they appear to be located where Pleistocene stream valleys previously existed. Holocene barrier islands apparently developed on drainage divide areas following post-Wisconsin transgression of the sea. The initial phase of tidal delta development was characterized by vertically accreting, fan-shaped, inlet-mouth bars; tidal channels stabilized after bar crests had shoaled sufficiently for marsh to form. With landward progradation across the lagoon, sand-rich deposits graded laterally away from the inlets and vertically into clayey sand and silty clay of the tidal flat bay and marsh environments. Ebb inlet-mouth bars developed asymmetrically southward in response to littoral drift. Flood tidal deltas also built preferentially toward the south as indicated by: (1) sand distribution of the inlet-mouth bar complex; and (2) greater development of marsh south of the inlets. (Knapp-USGS)  
W74-09099

**STOCHASTIC MODEL OF DYNAMIC EUTROPHIC ESTUARY,**  
Virginia Polytechnic Inst. and State Univ., Blacksburg.  
For primary bibliographic entry see Field 5B.  
W74-09114

**PROPOSED JETTY-HEAD REPAIR SECTIONS, HUMBOLDT BAY, CALIFORNIA,**  
Army Engineer Waterways Experiment Station, Vicksburg, Miss.  
For primary bibliographic entry see Field 8A.  
W74-09117

**BENTHOS IN ARAKUM BODIES OF WATER, (IN RUSSIAN),**  
Kaspiiskii Nauchno-Issledovatel'skii Institut Rybnogo Khozyaistva, Makhachkala (USSR).  
For primary bibliographic entry see Field 5C.  
W74-09142

## 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

### 3A. Saline Water Conversion

**SOME ASPECTS OF THE PROBLEM OF ARTIFICIAL DESALINATION OF NATURAL WATERS OF HIGH DISSOLVED-SALTS CONTENT (NEKOTORYYE ASPEKTY PROBLEMY ISKUSSTVENNOGO OPRESNENIYA PRIRODNYKH VOD POVYSHENNOY MINERALIZAT-SII),**  
Akademiya Nauk SSSR, Moscow. Institut Vodykh Problem.  
M. V. Sanin, and M. R. Nikitin.  
Vodnyye Resursy, No 4, p 14-36, 1973. 5 fig, 8 tab, 61 ref.

Descriptors: \*Desalination, \*Desalination processes, \*Desalination plants, \*Groundwater, \*Saline water, Brackish water, Sea water, Brines, Freshwater, Distillation, Ion exchange, Membrane processes, Electrodialysis, Reverse osmosis, Crystallization, Freezing, United States, Australia, Costs, Maps.  
Identifiers: \*USSR, \*Mineralization.

Desalination is discussed in connection with the use of highly mineralized groundwater for water supply. Estimates are made of groundwater resources for the United States, Australia, and the Soviet Union. Desalination methods most adaptable for processing groundwater are described, and data are given on Soviet and foreign desalting plants in operation and on their basic economic indices. Maps show distribution of saline groundwater in the United States, of groundwater of varying salinity on the Australian continent, and of brackish and saline groundwater in the USSR. (Josefson-USGS)  
W74-08711

**DEVELOPMENT OF A HIGH PRODUCT WATER RECOVERY SYSTEM FOR THE TREATMENT OF ACID MINE DRAINAGE BY REVERSE OSMOSIS,**  
Envirex, Inc., Milwaukee, Wis. Environmental Sciences Div.  
For primary bibliographic entry see Field 5D.  
W74-08841

**SEAWATER DESALINATION WITH PBI HOLLOW FIBER REVERSE OSMOSIS MEMBRANES,**  
Celanese Research Co., Summit, N.J.  
H. J. Davis, J. S. Soehngen, and F. S. Model.  
Available from the National Technical Information Service as PB-230 693/AS, \$6.25 in paper copy, \$1.45 in microfiche. Office of Saline Water. Report INT-OSW-RDPR-74-937, March 1974. 58 p, 18 fig, 17 tab, 5 ref. OSW Contract 14-30-3199.

Descriptors: \*Desalination, \*Membranes, \*Reverse osmosis, Permeability, Salt rejection, \*Annealing, Pretreatment, Chlorination, Sea water.  
Identifiers: \*Hollow fibers(PBI), Fiber spinning, In-line annealing.

Laboratory evaluations have shown that the reverse osmosis properties of PBI hollow fiber membranes are adequate for a single-pass desalination of seawater at an operating pressure of 1,000 psi. Against 3.5% (35,000 ppm) sodium chloride feed at 75F, product water with 250 to 350 ppm sodium chloride was obtained in long-term testing; similarly, against 3.6% (36,000 ppm) sea salt solution, product water with 250-350 ppm total dissolved solids was obtained -- well within limits commonly accepted for potable water. In field evaluation tests against chlorinated sea water at 1,000 psi and at about 55F, total dissolved solids

concentrations as low as 108 to 174 ppm were reported. High rejection values 98.8% to 99.4% were obtained and continued at these high levels over the long-term test periods. Product water flux ranged from 0.6 to 1.1 gfd in laboratory long-term testing at 75F and from 0.2 to 0.5 gfd in the field evaluation tests at 55F. (OSW)  
W74-08842

**APPLICATION OF EXTERNALLY WOUND TUBULAR MEMBRANE SYSTEMS FOR SEA WATER DESALINATION,**  
Universal Water Corp., San Diego, Calif.  
Serop Manjikian.  
Available from the National Technical Information Service as PB-229 730/AS, \$7.75 in paper copy, \$1.45 in microfiche. Office of Saline Water, Report INT-OSW-RDPR-74-929, March 1974. 86 p, 28 fig, 9 tab. OSW Contract 14-30-3107.

Descriptors: \*Desalination, Sea water, \*Reverse osmosis, \*Membrane processes, Pilot plants, Corrosion, Membranes.

Identifiers: Cellulose acetate membranes, Diacetate-triacetate membranes, Helical elements, Nylon-dacron backing materials.

The primary objective was the modification and adaptation of the externally wound tubular membrane element unit for use in high pressure sea water desalination. Various prototype modules were constructed and tested. Modular components, subassemblies and various materials of construction were evaluated in prototype modules with respect to their mechanical properties, corrosion resistance, and reliability when operated with sea water. The results indicated that the fabrication of cellulosic membrane systems for sea water is technologically and economically practical when the desired goal is 1000 ppm total dissolved solids or less and when operated at 1000 psi at a 20% recovery. With the determination of helical systems sea water operating parameters and the optimization of the externally wound tubular membrane element unit for high pressure applications, a bench scale pilot unit was designed and built for long term evaluation using sea water. (OSW)  
W74-08843

**FRAME FOR A SEMI-PERMEABLE MEMBRANE ASSEMBLY,**  
Rhône-Poulenc S.A., Paris (France). (Assignee)  
For primary bibliographic entry see Field 8C.  
W74-08898

**PRODUCTION OF FRESH WATER FROM THE ENDOGENOUS STEAM OF CERRO PRIETO GEOTHERMAL FIELD,**  
Comision Federal de Electricidad, Mexico City.  
L. F. De Anda, S. C. Reyes, and M. E. Tolviva.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1632-1635, 1973. 2 fig, 4 tab, 2 ref.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Mexico, \*Water supply, Water treatment, Saline waters, Potable water, \*Pilot plants.  
Identifiers: Geothermal power.

In the Cerro Prieto geothermal field, a pilot plant is used for production of freshwater using the endogenous steam. The cost of freshwater obtained is 1.39 Mexican pesos per cu/m. The cost of freshwater obtained competes with the cost of drinkable bottled water, which in Mexicali City is between 1.50 to 2.00 Mexican pesos for a 20 liter flask. (See also W74-08973) (Knapp-USGS)  
W74-09037

**APPLICATION OF REVERSE OSMOSIS TECHNOLOGY TO HAWAIIAN LOW QUALITY WATERS,**  
Hawaii Univ., Honolulu. Water Resources Research Center.  
For primary bibliographic entry see Field 5D.  
W74-09052

**DESALTING THE SEAS: A STEP TOWARD WORLD PEACE,**  
R. Schuessler.  
Oceans, Vol 4, No 5, p 64-69, September-October 1971. 4 photo.

Descriptors: \*Adoption of practices, \*Desalination plants, Distillation, Membrane processes, Water yield, Desalination wastes, Fertilizers, Nuclear energy, Cost analysis.

Like outer space in the 1960's, the oceans can now be regarded as the greatest challenge to man's pioneering spirit and engineering skill, and the 1970's could become the decade of the deep, the age of desalting plants. While steps have been taken toward that goal, much more must be done in both building plants and developing cheaper methods of desalting water if the needs of modern society are to be met. Studies show that 41% of water systems deliver water of poor quality. Costs are relatively high at present but certain technology will lower them, and then as a diplomatic means of communication, the U.S. could help the entire world solve their water crisis, preventing droughts and famines. For all the progress today, desalination experts have but scratched the surface in how best to desalt the seas. The two best methods used today are distillation and the membrane method. Some of the collateral aspects of desalination include production of fertilizer, helping to prevent environmental pollution and waste water management. The most promising new method is one that involves the use of nuclear energy in a dual-purpose plant which would power steam turbines to generate electricity and utilize the exhaust steam to evaporate and condense seawater. (Sutton-Florida)  
W74-09167

**PUBLIC RESPONSE TO DESALTED SEA WATER,**  
California Univ., Berkeley. School of Public Health.  
For primary bibliographic entry see Field 6D.  
W74-09171

**MULTI-STAGE FLASH DISTILLATION PLANT,**  
Industrial Science and Technology Agency, Tokyo (Japan). (Assignee)  
K. Sato, K. Kamiyama, and K. Tahara.  
U. S. Patent No 3,801,471. 3 p, 4 fig, 9 ref; Official Gazette of the United States Patent Office, Vol 921, No 1, p 297. April 2, 1974.

Descriptors: \*Patents, \*Desalination, \*Distillation, \*Flash distillation, \*Evaporators, \*Water treatment, \*Potable water, Sea Water.

A multi-stage flash evaporator is capable of producing fresh water in high yield by approximating the adiabatic evaporation process to the state of theoretical rate production. The apparatus comprises in combination, a series of flash evaporator stages connected in horizontal series and each partitioned by a plate. A baffle plate is disposed from an upper surface of each stage and defines an auxiliary flash chamber with a plate along one side of the stage and defines a flash chamber with a plate along the opposite side of the stage. The flash chamber has a demister, a condenser and a product tray disposed at the top. The demister is placed between the baffle plate and the plate at the opposite side of the stage and below the condenser and product tray. A seawater flow path connecting each adjacent pair of flash chambers is provided

near its open end on the low-pressure side. (Sinha-OEIS)  
W74-09174

**PROCESS AND APPARATUS FOR SOLAR DISTILLATION UTILIZING CELLULAR CERAMIC NODULES TO IMPROVE THE EVAPORATION RATE,**  
Pittsburgh Corning Corp., Pa. (Assignee)  
N. T. Castellucci, and N. C. Krouskop.  
U. S. Patent No 3,801,474. 6 p, 2 fig, 3 tab, 17 ref; Official Gazette of the United States Patent Office, Vol 921, No 1, p 298. April 2, 1974.

Descriptors: \*Patents, \*Solar distillation, \*Evaporation, \*Condensation, \*Desalination, \*Water quality, Sea water, Potable water, Distillation, Saline water.

A process is described for recovering fresh water from brine or salt water by solar distillation. A quantity of substantially spherical cellular ceramic nodules having an outer textured surface is positioned on the upper surface of a body of sea water within a container. The nodules float on the upper surface of the salt water in a partially submerged condition with the upper exposed surfaces of the nodules above the surface of the water. The upper surfaces of the nodules are wetted by the water and a relatively thin film is formed thereon. The film on the upper surface of the nodules is subjected to elevated temperatures by solar radiation and the water in the thin film evaporates and is continually replaced as a thin film from the body of water. The water vapor condenses on a covering surface over the container and is suitably collected. (Sinha-OEIS)  
W74-09179

**OBTAINING INCREASED HEAD IN WATER SYSTEMS,**  
G. D. James.  
U. S. Patent No. 3,795,587. 3 p, 4 fig, 8 ref; Official Gazette of the United States Patent Office, Vol 920, No 1, p 160, March 5, 1974.

Descriptors: \*Patents, \*Water vapor, \*Desalination, \*Condensation, \*Water supply, Water treatment.  
Identifiers: \*Power generation, Water head.

The method for gaining head in a water supply system in which water vapor is generated includes introducing the water vapor into a vertically extended zone and contacting the vapor with relatively cool water droplets moving through the zone condensing the vapor on the droplets, deflecting the droplets repeatedly upward in the zone and collecting the droplets with the condensate upon deflection to the top of the zone. The method further contemplates generating water vapor for introduction into the zone by subjecting relatively warm water to a reduced pressure. The water is introduced into the lower portion of the zone and is dispersed as droplets upward through the zone. Deflection of the droplets in an upward direction may be accomplished by sweeping the zone repeatedly with angularly disposed surfaces adapted to provide upward deflection of impacting droplets. The deflected droplet may be further deflected upward by impacting on a second superjacent surface. The deflection while always upward may have more or less of a horizontal component which is desirably varied from surface to surface impact. (Sinha-OEIS)  
W74-09187

## 3B. Water Yield Improvement

**AGRICULTURAL DEMAND FOR WATER IN THE PECOS RIVER BASIN: AN ADDENDUM,**  
New Mexico Univ., Albuquerque. Dept. of Economics.  
For primary bibliographic entry see Field 3F.  
W74-08756

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3B—Water Yield Improvement

#### WEATHER MODIFICATION.

For primary bibliographic entry see Field 6E.  
W74-09133

#### DESALTING THE SEAS: A STEP TOWARD WORLD PEACE.

For primary bibliographic entry see Field 3A.  
W74-09167

#### AUTHORITY TO LEASE SEA BOTTOM.

For primary bibliographic entry see Field 6E.  
W74-09168

#### PRECIPITATION AUGMENTATION-- PROBLEMS AND PROGRESS.

Texas Tech Univ., Lubbock. Dept. of Geosciences.  
D. R. Haragan.  
Water Resources Bulletin, Vol 10, No 3, p 547-554, June 1974, 10 ref.

Descriptors: \*Weather modification, \*Artificial precipitation, Cloud seeding, Reviews, Social aspects, Legal aspects, Water management(Applied).

Weather modification and precipitation management are reviewed. Coordination of efforts and intensification of both laboratory and field research could lead to major advances. Scientific efforts should be coordinated with a program designed to inform and educate the public on the role and potential of artificial precipitation augmentation. In addition, careful consideration must be given to social and legal issues. Environmental impact, land use, economic potential and damage liability are all factors of importance in any comprehensive analysis. Rational solutions to questions in each of these areas are dependent upon the establishment of a sound scientific basis for operational weather modification, which should be the first priority. (Knapp-USGS)  
W74-09198

#### A CLIMATOLOGY OF CUMULUS SEEDING POTENTIAL FOR THE WESTERN UNITED STATES.

Navy Weather Research Facility, Norfolk, Va.  
P. R. Lowe, D. C. Schertz, and D. A. Matthews.  
Available from NTIS, Springfield, Va. 22151 as AD-769 543 - Price \$6.50 printed copy; \$1.45 microfiche. Technical Paper No 4-71, February 1971, 78 p, 32 fig, 5 tab, 8 ref. USBR Contract 14-06-D-6989.

Descriptors: \*Cloud seeding, \*Weather modification, \*Simulation analysis, Mathematical models, Probability, Climatology, Synoptic analysis, \*Southwest U.S.

For rainfall enhancement through the seeding of cumulus clouds, no large body of information relative to the probable outcome of cloud modification exists. Lacking these data, recourse to mathematical simulation of cloud modification is the only means of estimating the likelihood of outcomes of such activity. The WEARSCHFAC-Penn State, one-dimensional, steady state, cumulus model, needs only a small amount of computer memory, and only very little time for processing atmospheric soundings in numbers sufficient to generate a climatology. The seeding procedure represented by the simulation case wherein all liquid water is converted to ice at -15 deg C shows considerably less potential for rainfall enhancement than the procedure represented by the simulation case for conversion at -8 deg C. In terms of increased absolute volumes of water delivered into watershed areas, larger clouds definitely show significantly more potential than smaller ones. There is no significant trend in the amounts of rainfall inhibition with respect to geography. (Knapp-USGS)  
W74-09222

#### IMPROVEMENT OF TROUT STREAMS IN WISCONSIN BY AUGMENTING LOW FLOWS WITH GROUND WATER.

Geological Survey, Washington, D.C.  
R. P. Novitzki.  
Available from Sup Doc, GPO, Washington, D C 20402 - Price \$0.55. Water-Supply Paper 2017, 1973. 52 p, 26 fig, 3 tab, 45 ref, append.

Descriptors: \*Low-flow augmentation, \*Water temperature, \*Wisconsin, Conjunctive use, Groundwater, Streamflow, Fishing, Trout.  
Identifiers: Little Plover River(Wisc), Black Earth Creek(Wisc).

Approximately 2 cubic feet per second of groundwater were introduced to augment low flow in the Little Plover River, Wisconsin in 1968 when natural streamflow ranged from 3 to 4 cubic feet per second. These augmentation flows were retained undiminished through the 2-mile reach of stream monitored. Maximum stream temperatures were reduced as much as 5 deg F at the augmentation site during the test period, although changes became insignificant more than 1 mile downstream. Maximum temperatures might be reduced as much as 10 deg F during critical periods, based on estimates using a stream-temperature model developed as part of the study. Augmentation flows of nearly 2.5 cubic feet per second of groundwater were introduced into the headwater reach of Black Earth Creek from the end of June through mid-October 1969. Augmentation flows were retained through the 8-mile reach of stream. Temperature of the augmentation flow as it entered the stream ranged from 60 deg to 70 deg F during the test period, and minimum stream temperatures were raised 5 deg F or more at the augmentation site, with changes extending from 2 to 3 miles downstream. Augmentation during critical periods could maintain stream temperatures between 40 deg and 70 deg F through most of the study reach. Dissolved oxygen levels were increased by as much as 2 milligrams per liter or more below the augmentation site. During critical periods DO improvement in the problem reach would be somewhat greater. (Knapp-USGS)  
W74-09224

### 3C. Use Of Water Of Impaired Quality

#### SEWAGE WATER IRRIGATION EFFECT ON COTTON GROWTH AND DEVELOPMENT, (IN RUSSIAN).

Desert Inst., Ashkhabad (USSR).  
For primary bibliographic entry see Field 5D.  
W74-08729

#### THE IMPROVEMENT OF POOR STRUCTURED BASIN DEPRESSION SOILS AT FUDHALIYA EXPERIMENTAL FIELD.

Institute for Applied Research on Natural Resources, Baghdad (Iraq).  
J. Dougrameji, B. A. TaKessian, and R. Van Art.  
Institute for Applied Research on Natural Resources, Baghdad, Iraq. Technical Bulletin 48, September 1973. 15 p, 4 fig, 6 tab, 4 ref.

Descriptors: \*Soil amendments, \*Soil texture, \*Gypsum, \*Planting management, Soil profiles, Organic matter, Alfalfa, Saturation, Lime, Salts, Soil chemistry, Irrigation, Groundwater, Soil water movement, Soil physical properties, Farm wastes.  
Identifiers: \*Iraq.

A reconnaissance survey in Central Iraq showed that 20 percent of the region is composed of irrigation depression soils with poor structure. The soils exhibit low permeability with puddles and compaction occurring following irrigation. Experiments were conducted using gypsum and farm manure as soil amendments, and a combination of farm manure and deep plowing was also tried.

Wheat and alfalfa were cultivated on these sites. No perceptible change occurred from the gypsum application as a result of a restricted plow depth and consequently restricted rooting depth. Application of farm manure resulted in increases of 11-13 percent in alfalfa yields and 25-31 percent for wheat plots. More drastic increases were believed to be hampered due to restricted plow and rooting depths. On plots that were deep plowed significant increases in yields from both crops were evident. The highest yields resulted from combinations of farm manure and deep plowing. (Mastic-Arizona)  
W74-08763

#### PENETRABILITY AND HYDRAULIC CONDUCTIVITY OF DILUTE SULFURIC ACID SOLUTIONS IN SELECTED ARIZONA SOILS.

Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.  
For primary bibliographic entry see Field 2G.  
W74-08765

#### SALINITY PROBLEMS OF THE SAFFORD VALLEY: AN INTERDISCIPLINARY ANALYSIS.

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
For primary bibliographic entry see Field 5B.  
W74-08769

#### NITROGEN METABOLISM OF STARGRASS AS AFFECTED BY NITROGEN AND SOIL SALINITY.

Department of Agriculture, Watkinsville, Ga.  
G. W. Langdale, J. R. Thomas, and T. G. Littleton.  
Agronomy Journal, Vol 65, No 3, p 468-470, May-June, 1973. 3 fig, 2 tab, 19 ref.

Descriptors: \*Fertility, \*Nitrogen, Fertilizers, \*Salinity, Nutrient removal, Leaching, Crop response, Saline soils, \*Metabolism.

Interactive effects of soil salinity and N fertilizer on stargrass growth and N metabolism were investigated. Nitrogen contents were partitioned to study the effects of substrate salinities on hydrolysis of protein-N and the accumulation nonprotein-N assimilates. Mixed chloride-sulfate solutions of the same ionic ratios and electrical conductivities (EC) of 4.8, 9.6, and 14.4 mmhos/cm were equilibrated with Brennan fine sandy loam soil, after which N was applied in a factorial arrangement at rates of 0, 67, 133, and 200 mg/kg of soil. Nitrogen fertilizer interacted significantly with soil salinity to stimulate dry matter and protein-N yields at the 4.8-mmhos/cm level. No evidence of a toxic nonprotein-N accumulation in plant tissue was observed even with high N fertilization at this salinity level. The 9.6-mmhos/cm salinity treatment was considerably more deleterious to dry matter than to protein-N production processes. (Skogerboe-Colorado State)  
W74-08806

#### CELL WALL PROPERTIES OF COTTON ROOTS AS INFLUENCED BY CALCIUM AND SALINITY.

Texas A and M Univ. Weslaco. Agricultural Research and Extension Center.  
C. J. Gerard, and E. Hinojosa.  
Agronomy Journal, Vol 65, No 4, p 556-560, July-August, 1973. 11 fig, 1 tab, 15 ref.

Descriptors: \*Salinity, \*Crop response, Calcium, Root development, \*Cotton(Field), \*Root system, Root zone.

Research was conducted to determine the influences of salinity and Ca uptake on cell wall properties of cotton roots. It was postulated that examination of cell wall properties might give insight on the role of Ca in moderating the influences of salinity and toxic ions on cellular stability and plant growth. Age and Ca are essential to the

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Conservation In Agriculture—Group 3F

development of thick cell walls in the stele. Thick cell walls exhibit high birefringence under polarized light. Salinity reduced Ca uptake and concentration of cotton roots. Xylem and phloem cell walls of cotton roots grown in solutions with sufficient Ca and low salinity thickened and in about 70 hours, exhibited high birefringence. Young cell walls in the pericycle or laterals did not exhibit birefringence. Even at adequate level of Ca, salinity retarded the development of thick cell walls and high birefringence in the stele to about 140 hours. (Skogerboe-Colorado State) W74-08808

**LEACHING REQUIREMENT STUDIES: SENSITIVITY OF ALFALFA TO SALINITY OF IRRIGATION AND DRAINAGE WATERS.** Agricultural Research Service, Riverside, Calif. Salinity Lab. L. Bernstein, and L. E. Francois. Soil Science of America Proceedings, Vol 37, No 6, p 931-943, November-December, 1973. 4 fig, 10 tab, 17 ref.

Descriptors: \*Salinity, \*Salt balance, \*Crop response, \*Leaching, \*Alfalfa, \*Lysimeters, \*Irrigation practices, Sodium, \*Drainage engineering.

Alfalfa was grown in 0.6 by 1.5 m greenhouse lysimeters and irrigated with two waters of EC 1 and 2 mmho/cm prepared by adding equivalent amounts of NaCl and CaCl<sub>2</sub> to a 0.4 mmho/cm tap water. Yields showed relatively little effect of leaching fraction (LF) within the limits consistent with steady-state salt balance for suction-drained lysimeters but decreased 26% at the lowest LF for gravity-drained lysimeters. Yields with the 2 mmho/cm irrigation water treatments were consistently about 10% less than those with the 1 mmho/cm water. Cessation of leaching or reduction of LF to levels requiring drainage water salinities for salt balance at steady state to exceed 35 mmho/cm, the maximum salinity achievable by alfalfa roots, eventually reduced yields. Yields were significantly higher when leaching was done every third or sixth irrigation than in every irrigation while maintaining the same average LF of 1/32 and 1/16 for the 1 and 2 mmho/cm irrigation waters, respectively. (Skogerboe-Colorado State) W74-08815

**GROWTH, MINERAL COMPOSITION, AND SEED OIL OF SESAME (SESAMUM INDICUM L.) AS AFFECTED BY NaCl.** California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering. Y. H. Yousif, F. T. Bingham, and D. M. Yermanos. Soil Science Society of America Proceedings, Vol 36, No 3, p 450-453, May-June, 1972. 2 fig, 4 tab, 20 ref.

Descriptors: \*Salinity, \*Crop response, Sodium, Chlorides, Seeds, \*Sodium chloride, \*Oilseed crops, \*Growth, \*Mineralogy. Identifiers: \*Sesame.

The tolerance of sesame to NaCl salinity was studied first during germination, and later during plant growth up to maturity. Germination was conducted in the laboratory at 25°C. Sesame plants were tested for response to salinity using nutrient solution cultures with sodium chloride added when test plants were approximately 10 cm tall. Experiments were continued until mature seed pod formation. The data showed a high tolerance during germination but sensitivity at later growth stages. (Skogerboe-Colorado State) W74-08816

**SALINITY-OZONE INTERACTIVE EFFECTS ON YIELD AND WATER RELATIONS OF PINTO BEAN.** Agricultural Research Service, Riverside, Calif. Salinity Lab.

For primary bibliographic entry see Field 5C. W74-08922

**INVENTORY OF WASTE WATER PRODUCTION AND WASTE WATER RECLAMATION PRACTICES IN CALIFORNIA, 1970-1971.** California State Dept. of Water Resources, Sacramento. For primary bibliographic entry see Field 5D. W74-09078

### 3D. Conservation In Domestic and Municipal Use

**DIRECT FILTRATION: AN ECONOMIC ANSWER TO A CITY'S WATER NEEDS.** Springfield Municipal Water Works, Mass. Water Dept. For primary bibliographic entry see Field 5D. W74-08788

**TALE OF TWIN CITIES, CUTTING THE HIGH COSTS OF POLLUTION CONTROL.** For primary bibliographic entry see Field 5D. W74-08796

**EVALUATING WATER REUSE ALTERNATIVES IN WATER RESOURCES PLANNING.** Utah State Univ., Logan. Center for Water Resources Research. For primary bibliographic entry see Field 5D. W74-08940

**PRODUCTION OF FRESH WATER FROM THE ENDOGENOUS STEAM OF CERRO PRIETO GEOTHERMAL FIELD.** Comision Federal de Electricidad, Mexico City. For primary bibliographic entry see Field 3A. W74-09037

**WATER CONSERVATION.** For primary bibliographic entry see Field 6E. W74-09159

### 3E. Conservation In Industry

**PROCEDURAL PROBLEMS IN PROJECTED PLANNING OF WATER CONSUMPTION AND DIVERSION BY INDUSTRY IN THE USSR (METODICHESKIYE VOPROSY RASCHETA VODOPOTREBLENiya I VODOOTVEDENiya V PROMYSHLENNOSTI SSSR NA PERSPEKTIVU).** Akademiya Nauk SSSR, Moscow. Institut Vodykh Problem. B. G. Blagoverov. Vodnyye Resursy, No 4, p 37-42, 1973.

Descriptors: \*Water utilization, \*Diversion, \*Water requirements, \*Industrial production, \*Future planning(Projected), Human population, Urbanization. Identifiers: \*USSR.

Major water users in the Soviet national economy are agriculture (irrigation) and industry (including thermal powerplants). In 1970 the discharge of freshwater in all branches of Soviet industry was about 90 cu km or about 40% of total water intake from sources. Approximately 10% of water presently used by industry cannot be recovered. Diversion of flow reaches more than 80 cu km a year. Almost 90% of the water returned by industrial enterprises and thermal powerplants is diverted in either a partially treated or totally untreated form. Techniques are presented for calculating industrial water requirements for the USSR. For projected planning, data are needed on volume of production by types of industry within

economic regions and on projected water consumption rates. Water consumption and diversion data obtained from economic regions should be examined in relation to river basins. In the absence of sufficient data, water distribution should be based on projections of urban population. As much as 90%-95% of water consumed and diverted in the Volga Economic Region should be transferred to the Volga River, 4%-8% to the Don River (part of the Penza, Saratov, and Volgograd Oblasts) and 1%-2% to the Ural River (part of the Bashkir ASSR). (Josefson-USGS) W74-08710

**UTILIZATION OF THERMAL WATERS FROM OIL DEPOSITS OF THE CAUCASUS.** Groznenskiy Neftyanoy Institut (USSR). For primary bibliographic entry see Field 4B. W74-08988

**GEOTHERMAL FIELDS IN JAPAN CONSIDERED FROM THE GEOLOGICAL AND PETROLOGICAL VIEW POINT.** Hokkaido Univ., Sapporo (Japan). Dept. of Geology and Mineralogy. For primary bibliographic entry see Field 2F. W74-08997

**CURRENT STATUS OF GEOTHERMAL POWER PLANTS AT THE GEYSERS, SONOMA COUNTY, CALIFORNIA.** Pacific Gas and Electric Co., San Francisco, Calif. Dept. of Engineering. For primary bibliographic entry see Field 4B. W74-09035

**TRACE METALS IN EFFLUENTS FROM METALLURGICAL OPERATIONS.** Battelle Columbus Lab., Ohio. For primary bibliographic entry see Field 5D. W74-09212

**POLLUTION ABATEMENT IN THE METAL FINISHING INDUSTRY.** Environmental Protection Agency, Edison, N.J. For primary bibliographic entry see Field 5D. W74-09213

**CONTROL AND PREVENTION OF MINE DRAINAGE.** Environmental Protection Agency, Cincinnati, Ohio. For primary bibliographic entry see Field 5D. W74-09214

**POLLUTION ABATEMENT IN A COPPER WIRE MILL.** Environmental Protection Agency, Washington, D.C. Div. of Technology Transfer. For primary bibliographic entry see Field 5G. W74-09244

### 3F. Conservation In Agriculture

**PROCEDURAL PROBLEMS IN PROJECTED PLANNING OF WATER CONSUMPTION AND DIVERSION BY INDUSTRY IN THE USSR (METODICHESKIYE VOPROSY RASCHETA VODOPOTREBLENiya I VODOOTVEDENiya V PROMYSHLENNOSTI SSSR NA PERSPEKTIVU).** Akademiya Nauk SSSR, Moscow. Institut Vodykh Problem. For primary bibliographic entry see Field 3E. W74-08710

**CONTROLLED ENVIRONMENT STUDIES OF THE EFFECTS OF VARIABLE ATMOSPHERIC**

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3F—Conservation In Agriculture

**WATER STRESS ON PHOTOSYNTHESIS, TRANSPIRATION, AND WATER STATUS OF ZEA MAYS L. AND OTHER SPECIES.** Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Div. of Irrigation Research.

For primary bibliographic entry see Field 2D.  
W74-08754

**COTTON LEAF TEMPERATURES AS RELATED TO SOIL WATER DEPLETION AND METEOROLOGICAL FACTORS.** Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

W. L. Ehler.  
Agronomy Journal, Vol 65, p 404-409, May-June 1973. 4 fig, 3 tab, 9 ref.

Descriptors: \*Cotton, \*Air temperature, \*Rates of application, \*Moisture deficit, \*Soil-water-plant relationships, Leaves, Irrigation practices, Saturation, gravimetric analysis, potentiometers, stomata, Vapor pressure, Evaporation, Regression analysis.

The feasibility of using air temperature difference and moderate soil water depletion relationships as a possible guide for irrigation scheduling of cotton was investigated. Data were gathered during six irrigation cycles during two summers. The experimental plots were irrigated on a schedule to obtain a high lint yield. Results showed it was possible to measure a rise in air temperature difference accompanying a moderate soil water depletion, but the saturation deficit of the air must also be known. Precautions must be taken to make accurate measurements of leaf temperature, air temperature, and vapor pressure through the irrigation cycle. Attention must be paid to species involved. Use of this method is restricted to predominantly sunny regions, but further development is necessary to obtain values predicting maximum yields. (Mastic-Arizona)  
W74-08755

**AGRICULTURAL DEMAND FOR WATER IN THE PECOS RIVER BASIN: AN ADDENDUM.** New Mexico Univ., Albuquerque. Dept. of Economics.

M. Gisser.  
Water Resources Research, Vol 9, No 5, p 1429-1432, October 1973. 4 tab, 2 ref.

Descriptors: \*Water demand, Imported water, \*Groundwater recharge, \*Phreatophytes, Aquifers, Salinity, Evaporation, Pumping, Irrigation, New Mexico, Texas.

Identifiers: \*Pecos River(N.Mex.-Tex).

This addendum explores some questions proposed in two earlier studies on importing water to meet agricultural demand in the Pecos River Basin. The first assumed that the water would be stored on the ground if not immediately used. In the second the assumption was that the imported water would be recharged artificially to the aquifer for storage and to reduce high evaporation rates. Some problems posed by earlier studies are defined in this report, particularly salinity constraints and the possibility of reducing natural discharge of water by lowering the evaporation rate of salt cedars and other solutions such as irrigation systems. However, alternative technologies are not sufficiently developed to allow complete evaluation. (See also W70-10055, and W73-04277) (Mastic-Arizona)  
W74-08756

**AIR TEMPERATURE AND VAPOR PRESSURE CHANGES CAUSED BY SPINKLER IRRIGATION.**

Agricultural Research Service, Kimberly, Idaho. Snake River Conservation Research Center.  
R. A. Kohl, and J. L. Wright.  
Agronomy Journal, Vol 66, p 85-88, January-February 1974. 2 fig, 2 tab, 14 ref.

Descriptors: \*Evaporation, \*Air temperature, \*Humidity, \*Vapor pressure, \*Sprinkler irrigation, Evapotranspiration, Solar radiation, Wind velocity.

Evaporation from a sprinkler irrigation system was investigated to determine whether air temperature and vapor and vapor pressure downwind were changed enough to offset plant growth and water use. Wet-bulb and dry-bulb temperatures were measured along with wind speed and direction. As a result of spray evaporation, air temperature was reduced less than 1 degree C and vapor pressure in the air was increased less than 0.8 mb. The effects are considered insignificant when compared to the influence of an actively transpiring crop; and compared with diurnal and cyclonic temperature changes, the sprinkler effects are very small. The amount of change in air temperature and humidity is not likely to produce any significant change in plant growth or evaporation losses of water. (Mastic-Arizona)  
W74-08757

**THE IMPROVEMENT OF POOR STRUCTURED BASIN DEPRESSION SOILS AT FUDHALIYA EXPERIMENTAL FIELD.**

Institute for Applied Research on Natural Resources, Baghdad (Iraq).

For primary bibliographic entry see Field 3C.

W74-08763

**ORGANIC MANAGEMENT REDUCES LEACHING OF NITRATE.**

For primary bibliographic entry see Field 5G.

W74-08773

**COMPARATIVE STUDY ON THE INTERACTIVE EFFECT OF QUALITIES OF IRRIGATION WATER AND FERTILIZER LEVELS ON THE YIELD OF WHEAT GROWN ON DIFFERENT SOILS.**

Udaipur Univ. (India). Coll. of Agriculture.

P. Lal, and K. S. Singh.

Z. Acker-Pflanzenbau, Vol 136, No 4, p 302-308, 1972.

Identifiers: Comparative studies, Electrical conductivity, \*Fertilizers, \*Irrigation water, \*Sodium adsorption ratio, Soils, \*Wheat, Crop production.

Grain and straw yields decreased with increasing levels of electrical conductivity (EC) or Na adsorption ratio (SAR) of irrigation water, but at every level of EC or SAR of irrigation water, better yields were obtained with the higher dose of fertilizers than with the lower dose. Fertilization tended to offset the adverse effect of higher level of EC or SAR of water. The effect of fertilization decreased as the level of EC and SAR of water increased. Reduction in yields with an increase in salt concentration of irrigation water was small on sandy and loamy sand soils as compared to sandy loam and loam soils.--Copyright 1973. Biological Abstracts, Inc.  
W74-08779

**ASPECTS OF WATER POLLUTION IN FERTILISER INDUSTRY.**

Central Public Health Engineering Research Inst., Nagpur (India).

For primary bibliographic entry see Field 5C.

W74-08791

**INTERACTION EFFECTS OF BORON AND LIME ON BARLEY.**

Department of Agriculture, Charlottetown, (Prince Edward Island). Research Station.

U. C. Gupta.

Soil Science Society of America Proceedings, Vol 36, No 2, p 332-334, March-April, 1972. 3 tab, 15 ref.

Descriptors: \*Nutrient requirements, \*Trace elements, \*Boron, \*Toxicity, Crop response, \*Barley, Salts, Salinity, \*Lime.

A greenhouse study involving six levels of B and four levels of lime was conducted on barley. Boron toxicity symptoms occurred at 0.5 to 4.0 ppm applied B, with the most severe symptoms occurring at 4.0 ppm B level at soil pH 5.3. At 0.5 ppm B, no visible symptoms occurred at pH values of 6.3 and 6.8, and at 1.0 ppm B no symptoms occurred at pH 6.8. There was a highly significant soil pH x B interaction, in which high rates of B were more detrimental to kernel yields at lower pH than at high pH values. The highest kernel yields were recorded with 0.25 ppm B at soil pH 5.8. An application of 4.0 ppm B at soil pH 5.3 and 5.8 did not produce any kernels. A range in the B concentration of 1.4 to 9.9 ppm and in Ca/B ratio of 343 to 1,159 in the boat stage tissue (b.s.t.) collected from Prince Edward Island fields indicated a deficiency of B in many soils for growing barley. However, no visible B deficiency symptoms were found either under greenhouse or field conditions. (Skogerboe-Colorado State)  
W74-08799

**TYPES OF IRRIGATION SYSTEMS.**

North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.

R. E. Sneed.

Irrigation Journal, Vol 23, No 5, p 6-9, September-October, 1973.

Descriptors: \*Irrigation, \*Irrigation systems, Irrigation practices, Application equipment, Distribution systems, Irrigation systems, \*History.

A brief history of irrigation is presented along with census figures of the growth of irrigation in recent years. The types of irrigation systems are discussed. The limitations and requirements of each type are discussed briefly. (Skogerboe-Colorado State)  
W74-08800

**PLANT WATER STATUS IN RELATION TO CLOUDS.**

Georgia Coastal Plain Experiment Station, Tifton.

For primary bibliographic entry see Field 2D.

W74-08801

**RESPONSE OF SUBIRRIGATED HAY MEADOWS TO THE APPLICATION OF NITROGEN, PHOSPHORUS, AND SULFUR.**

Nebraska Univ., Concord, Northeast Station.

G. W. Rehm, W. J. Moline, R. C. Sorensen, and D. F. Burzlaff.

Agronomy Journal, Vol 65, No 4, p 665-668, July-August, 1973. 4 fig, 7 tab, 7 ref.

Descriptors: \*Fertilizers, \*Nitrogen, \*Phosphorus, Fertility, Hay, Yield equations, \*Sulfur, \*Grasses, Nutrients.

A study was designed to evaluate the effect of five rates of N, P and S on the yield and grass-legume composition of subirrigated meadows. Forage yields were recorded and separations made to determine grass-legume composition. Yields increased linearly with applied N while the response to P was curvilinear. There was no response to S. The percentage of grass in the meadows increased with applied N. Legume percentages increased with added P. Grass yields showed a linear increase with applied N and a curvilinear response to added P. Legume yields decreased linearly at low P rates when high rates of N were applied but increased curvilinearly as P rates were increased. Throughout the study, combinations of N and P produced the highest yields, thus demonstrating the importance of the combination of these two nutrients for maximum production from subirrigated hay meadows. (Skogerboe-Colorado State)  
W74-08802

**EFFECT OF SUPPLEMENTAL WATER ON BARLEY AND CORN PRODUCTION IN A SUB-HUMID REGION,**

Agricultural Research Service, Northern Great Plains Research Center, Mandan, N.D.

J. F. Power, J. J. Bond, W. A. Sellner, and H. M. Olson.

Agronomy Journal, Vol 65, No 3, p 464-467, May-June, 1973. 1 fig, 4 tab, 6 ref.

Descriptors: \*Irrigation, \*Irrigation practices, \*Supplemental irrigation, Irrigation programs, Irrigation effects, \*Corn(Field), \*Barley.

A 3-year field experiment was conducted on a loam soil in eastern North Dakota to determine the effect of supplemental water, added in various quantities and at different times, on malting barley and corn silage production. Irrigation consisted of (a) none; (b) after previous harvest only (to fill 120-cm profile); (c) 6 cm applied per irrigation as needed during growing season; (d) after previous harvest plus 6 cm at anthesis; (e) after previous harvest plus 6 cm applied as needed during the growing season; and (f) after previous harvest plus 9 to 12 cm applied as needed during the growing season. Water added after harvest was not reflected in soil water content by seeding time the following spring or in increased crop yields, indicating that fall irrigation was of little value. A linear regression existed between total water use and both barley grain and corn silage production, with no distinct differences between the six water treatments evident. (Skogerboe-Colorado State) W74-08803

**DEVELOPMENT OF AUTOMATED SURFACE IRRIGATION,**

Department of Agriculture, Lethbridge (Alberta). Research Station.

K. Pohjakas.

Canadian Agricultural Engineering, Vol 14, No 2, p 72-74, December, 1972.

Descriptors: \*Irrigation practices, \*Irrigation systems, \*Automation, Automatic control, Surface irrigation, Furrow irrigation, Border irrigation, Irrigation.

Surface irrigation by manual methods, because of its high labor requirement, is rapidly being replaced by automated sprinkler irrigation. Various gates, valves, dams, and weirs have been developed that, when used, enable a surface irrigation system to function automatically or by remote control. These components must be reliable, inexpensive, and simple to operate. Hardly any of the recently developed components are being manufactured for commercial use. Automated equipment can reduce the labor requirement of the traditional surface irrigation. Further developmental work, field testing, and commercial production of automatic water control devices are necessary to make surface irrigation competitive with other more automatic systems of irrigation. (Skogerboe-Colorado State) W74-08804

**YIELD RESPONSE OF SOYBEAN VARIETIES GROWN AT TWO SOIL MOISTURE STRESS LEVELS,**

Ohio Agricultural Research and Development Center, Wooster.

H. J. Mederski, and D. L. Jeffers.

Agronomy Journal, Vol 65, No 3, p 410-412, May-June, 1973. 2 tab, 12 ref.

Descriptors: \*Irrigation, \*Irrigation practices, \*Soil moisture, \*Crop response, \*Soybeans, Stress, Droughts.

Eight soybean varieties in each of four maturity groups were grown to maturity at optimum and deficient soil moisture conditions to determine differences in varietal response to soil stress. A significant variety by stress level interaction on seed

yield was detected among varieties in each of four maturity groups, indicating that the effect of soil moisture stress on yield varied among varieties. Under high moisture stress conditions, the yield of the most stress-resistant varieties was reduced about 20%, while the yield of the least stress-resistant varieties was reduced about 40%. Under conditions of optimum soil moisture, the difference in yield among varieties was large relative to the difference in yield produced under deficient moisture conditions. A low or nonstress soil moisture level permits greater genotypic expression, thereby increasing genotypic variance among varieties. A low soil moisture stress environment appears to be the optimum environment for selecting soybean yield attributes. (Skogerboe-Colorado State) W74-08805

**PIMA COTTON LINT YIELD AS INFLUENCED BY IRRIGATION SCHEDULE, CULTIVAR AND ALTITUDE,**

Agricultural Research Service, Phoenix, Ariz.

D. L. Kittok.

Agronomy Journal, Vol 65, No 3, p 498-501, May-June, 1973. 4 fig, 2 tab, 9 ref.

Descriptors: \*Irrigation, \*Irrigation practices, \*Crop response, \*Cotton(Field), Water conservation, Yield equations.

Development of heat tolerant cultivars of American Pima cotton made it desirable to re-evaluate irrigation practices for hot climates. To accomplish this, two cultivars and one experimental strain were tested over a period of 6 years at two altitudes and under several irrigation regimes. There were three basic irrigation regimes and several modifications of them. The regime were: wet, irrigate every 7 to 12 days; medium, 14 to 17 days; and dry, 21 to 28 days. Individual irrigations were added in amounts necessary to refill the soil profile. At high altitude, the heat tolerant cultivar, 'Pima S-4', did not differ in water requirement from the non-heat tolerant cultivar, 'Pima S-3'. Both cultivars obtained maximum lint production with a total of 80 cm of water or five post-emergence irrigations. At low altitude, Pima S-4 yielded higher and required more water than Pima S-3. (Skogerboe-Colorado State) W74-08807

**REFLECTANCE, TRANSMITTANCE, AND ABSORPTANCE OF LIGHT BY SUBCELLULAR PARTICLES OF SPINACH (SPINACIA OLERACEA L.) LEAVES,**

Agricultural Research Service, Weslaco, Tex.

H. W. Gausman.

Agronomy Journal, Vol 65, No 4, p 551-553, July-August, 1973. 2 fig, 16 ref.

Descriptors: \*Photosynthesis, \*Reflectance, Chlorophyll, Energy conversion, Plant physiology, \*Absorption.

Identifiers: \*Spinach.

Subcellular particles of spinach leaves were differentially sedimented and resuspended in a buffered sucrose solution. A spectrophotometer was used to measure R and transmittance (T) over the 500- to 2,500-nm wavelength interval (WLI) on replicated aliquots of five preparations: buffered sucrose solution; chloroplast preparation; S1, sediment of chloroplast preparation supernatant; S2, sediment of S1 supernatant; and S3, sediment of S2 supernatant. All suspensions of particulates caused less R than the buffered sucrose solution over the 500- to 650-nm WLI. The chloroplast preparation, compared with the buffered sucrose solution, increased R over the 750- to 950-nm WLI. The chloroplast preparation, compared with the buffered sucrose solution, S2, and S3, decreased T over the 500- to 1,250-nm WLI; S1 decreased T over the 500- to 900-nm WLI. A conclusion was reached that subcellular particles in leaves contribute to the R and A of IR light. (Skogerboe-Colorado State)

W74-08809

**IONIC BALANCE FOR BARLEY AS INFLUENCED BY P FERTILITY, WATER, AND SOIL TEMPERATURE,**

Agricultural Research Service, Northern Great Plains Research Center, Mandan, N. Dak.

R. F. Follett, and G. A. Reichman.

Agronomy Journal, Vol 65, No 3, p 477-482, May-June, 1973. 4 fig, 1 tab, 23 ref.

Descriptors: \*Nutrient removal, \*Leaching, \*Phosphorus, \*Barley, Ion transport, Fertility, \*Fertilizers, Soil water, Soil temperature.

The relationship between organic anion concentration and yield of spring barley was investigated in a growth room at three levels of P. This relationship was tested at three levels of available soil water (W) and three soil temperatures (T). The concentration of organic anions was determined as the difference between the sum of the meq/kg of inorganic cations and the sum of the meq/kg of inorganic anions. A normal organic anion (C-A) concentration was considered to be that giving optimal growth. In this study, P was more important for obtaining a normal (C-A) than either W or T. Phosphorus increased yields, decreased (C-A) to near normal, and decreased the adverse effects of low W and low T. The large differences in (C-A) between treatments suggests that, under adverse conditions, organic anions may serve as reservoirs of useful metabolites. (Skogerboe-Colorado State) W74-08810

**WATER STRESS RELATIONS OF THE POTATO PLANT UNDER FIELD CONDITIONS,**

Agricultural Research Service, Orono, Maine.

E. Epstein, and W. J. Grant.

Agronomy Journal, Vol 65, No 3, p 400-404, May-June, 1973. 9 fig, 15 ref.

Descriptors: \*Soil moisture, \*Crop response, \*Potatoes, Water requirements, Water utilization, Stress, \*Maine.

Potatoes grown in northern Maine are often subjected to extensive periods of drought. The objective of this study was to examine the physiological response of potatoes to soil water stress. Relative water content, leaf diffusive resistance, and tuber water potential of two potato varieties were measured under irrigated and nonirrigated conditions. There were pronounced differences in relative water content, leaf diffusive resistance, and tuber water potential as a result of irrigation. Relative water content (RWC) of plant leaves correlated well with soil water potential but poorly with leaf diffusive resistance. The two potato varieties differed in RWC when soil water potential was high. Tuber water potential correlated well with RWC and soil water potential. Similarity between tuber water potential and the RWC data suggested that the potato plant exhibits water stress when the soil water potential drops below -0.25 bar. (Skogerboe-Colorado State) W74-08811

**COTTON LEAF TEMPERATURES AS RELATED TO SOIL WATER DEPLETION AND METEOROLOGICAL FACTORS,**

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

W. L. Ehrler.

Agronomy Journal, Vol 65, No 3, p 404-409, May-June, 1973. 4 fig, 3 tab, 9 ref.

Descriptors: \*Irrigation, \*Irrigation practices, \*Crop response, \*Cotton, Soil moisture, Tension, \*Soil water.

In two field experiments with cotton, the relation between moderate soil water depletion and leaf-air temperature difference ( $\Delta T$ ) was investigated for feasibility of measurement and possible use as

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3F—Conservation In Agriculture

a guide to irrigation scheduling. Hourly temperatures of the upper leaves and of the air 1 m above the canopy were obtained for three cultivars of short-staple cotton and one of long-staple. In addition, hourly measurements were made of the vapor pressure 1 m above the crop. These data were taken during six irrigation cycles extending over two summers and encompassing a wide range of saturation deficit (SD). The temperature differences were measurable and predictable. When the SD remained steady from day to day, the mean daytime Delta T decreased 1 C on the day of irrigation and an additional degree the next day owing to leaf rehydration and consequent stomatal opening. (Skogerboe-Colorado State)  
W74-08812

**EFFECT OF LONG-TERM MANAGEMENT ON PHYSICAL AND CHEMICAL PROPERTIES OF THE COSHOCTON WATERSHED SOILS.**  
Agricultural Research Service Coshocton, Ohio. North Appalachian Experimental Watershed. For primary bibliographic entry see Field 4D.  
W74-08813

#### 1973 IRRIGATION SURVEY.

Irrigation Journal, Vol 23, No 6, p 11-20, November-December, 1973.

Descriptors: \*Irrigation, \*Irrigation practices, Irrigation systems, \*Surveys, Reviews.

A state-by-state summary is presented of irrigated acreage for selected years since irrigation was begun in the state. The following data are also given: percent change per year, amount sprinkled, type of power used by percent, method of irrigation, irrigated acreage by crop, and amount irrigated by gravity. (Skogerboe-Colorado State)  
W74-08817

**CONTROLLED SPRINKLER IRRIGATION SYSTEM FOR EQUALIZED WATER DISTRIBUTION DEVELOPED IN ISRAEL.**  
Rhodesia Agricultural Journal, Vol 69, No 4, p 75-76, July-August, 1972. 2 fig.

Descriptors: \*Irrigation practices, \*Distribution systems, Irrigation systems, \*Sprinkler irrigation, Application equipment, Irrigation efficiency.  
Identifiers: \*Israel.

A new irrigation system has been developed in Israel to achieve maximum controlled water distribution on permanent set sprinkler schemes. Equalized water distribution with the new sprinkler offers the obvious advantage of ensuring against over-saturating areas served by the first sprinklers or under-irrigating the last points in the network. It prevents water wastage resulting from over-discharge in the first units to compensate for the loss caused by the drop of pressure--up to 20 percent--as the result of friction over the length of the irrigation pipe and changes in topography experienced in conventional systems. The savings in water due to complete regulation of the outflow of each sprinkler is said to range from five to 15 percent of the total water use for a given plot, depending upon pressure and topographical conditions. These are low discharge sprinklers designed for use in all types of fruit orchards for under-the-foliage fixed irrigation. (Skogerboe-Colorado State)  
W74-08818

**NITROGENOUS COMPOUNDS IN THE ENVIRONMENT.**  
Environmental Protection Agency, Washington, D.C. Hazardous Materials Advisory Committee. For primary bibliographic entry see Field 5B.  
W74-08835

**SOIL CRUSTING RELATED TO SPRINKLER INTENSITY.**  
Auburn Univ., Ala. Dept. of Agricultural Engineering.  
C. D. Busch, E. H. Rochester, and C. L. Jernigan. Transactions of the ASAE (American Society of Agricultural Engineers), Vol 16, no 4, p 808-809, 1973. 5 fig, 2 tab, 10 ref. OWRR A-025-ALA(1).

Descriptors: \*Sprinkler irrigation, \*Soil strength, \*Soil density, \*Regression analysis, \*Irrigation practices, Rainfall, Soil texture, Rain gages, Rain-fall simulators.  
Identifiers: \*Soil crusting, Penetrometer.

Investigations of sprinkler intensities and their influence on crust strength after one and repeated irrigation cycles were made. Regression analyses were done correlating penetrometer readings of crust strength and crust moisture data. Preliminary results showed that previous sprinkling can reduce strength of crust formed by a subsequent rainfall. Other results showed that lower sprinkler intensities consistently produced a weaker crust, and that increasing numbers of water application cycles failed to show a consistent influence on crust strength. (Mastic-Arizona)  
W74-08844

**BORON RELEASE FROM DEIONIZERS.**  
California Univ., Los Angeles. Dept. of Environmental Horticulture.  
For primary bibliographic entry see Field 5B.  
W74-08873

**A COMPUTER SIMULATION OF CORN GRAIN PRODUCTION.**  
Missouri Univ., Columbia. Dept. of Agronomy.  
C. H. Baker, and R. D. Horrocks. Transactions of the ASAE (American Society of Agricultural Engineers), Vol 16, No 6, p 1027-1029, 1031, November-December, 1973. 3 tab, 22 ref.

Descriptors: \*Computer models, \*Mathematical models, \*Plant growth, \*Corn(Field), Crop response, Model studies, \*Crop production, \*Simulation analysis.

When the ideal simulation model is pictured, it is evident that the trend of crop research needs to be changed. Instead of researching a plant on a monthly or seasonal basis, it should be considered on a daily basis. The corn plant, like most biological systems, is a highly variable and highly buffered system. A system of this complexity does not respond to average or monthly weather -- instead it is affected each day by that day's weather. The effect of similar weather on two successive days also differs to a degree since the plant has changed. In a month's time, the plant can change many times. Development of a simulation model is not limited by computer capacity, but rather is limited by lack of mathematical definitions for the basic plant processes. (Skogerboe-Colorado State)  
W74-08917

**TRICKLE IRRIGATION -- APPLICATION UNIFORMITY FROM SIMPLE EMITTERS.**  
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
D. A. Bucks, and L. E. Myers. Transactions of the ASAE (American Society of Agricultural Engineers), Vol 16, No 6, p 1108-1111, November-December, 1973. 4 fig, 3 tab, 12 ref.

Descriptors: \*Irrigation practices, \*Surface irrigation, \*Application equipment, Uniformity coefficient, Irrigation systems, \*Irrigation design, Construction, Design.  
Identifiers: \*Drip irrigation.

Procedures for design and construction of two multiple-size systems, using a stainless-steel and

microtube or spaghetti-tube emitter, were developed. Mean discharge deviations for these simple emitters operated at constant pressure were from 1.7 percent to 3.3 percent for the stainless-steel emitters, and from 1.8 percent to 2.5 percent for the microtube emitters. Performance by a multiple-diameter stainless-steel emitter system designed for row-crop usage verified the practicality of changing emitter diameters along the lateral. The theoretical performance of a 250-foot lateral with a 2-foot emitter spacing, using five sizes of stainless-steel emitters, showed a mean deviation of 1.7 percent and maximum deviations of +5.2 percent to -6.6 percent from design discharge. Actual mean deviation from design discharge was 3.1 percent, with maximum deviations of +8.8 percent to -10.8 percent in the field. (Skogerboe-Colorado State)  
W74-08918

**EVALUATION OF GRADED FURROW IRRIGATION WITH LENGTH OF RUN ON A CLAY LOAM SOIL.**

Agricultural Research Services, Bushland, Tex. Southwestern Great Plains Research Center. J. T. Musick, W. H. Sletten, and D. A. Dusek. Transactions of the ASAE (American Society of Agricultural Engineers), Vol 16, No 6, p 1075-1080, 1084, November-December, 1973. 11 fig, 1 tab, 13 ref.

Descriptors: \*Irrigation practices, \*Furrow irrigation, \*Infiltration rates, Surface irrigation, Runoff, Infiltration, Inflow, \*Texas, Soil water, Crop production, \*Sorghum, Clay loam.  
Identifiers: Graded furrows.

The effects of length of run on water intake, soil water distribution, grain sorghum yields and irrigation water use efficiencies were evaluated on graded furrow irrigated Pullman clay loam at Bushland, Texas, in 1961-63 on a 900-foot run and in 1965-66 on an 1,800-foot run. Total water intake during the 15 irrigations studied ranged from 1.3 to 6.0 inches, depending primarily on soil water content at time of irrigation and surface soil consideration. Intake rates after runoff started were affected by length of run. As water advanced down the furrows, an increasing portion of the furrow length reached the basic rate which caused the average rate for the wetted furrow length to decline. (Skogerboe-Colorado State)  
W74-08927

**RATIONALE FOR OPTIMUM NITROGEN FERTILIZATION IN CORN PRODUCTION.**  
Agricultural Research Service, Beltsville, Md. Soils Lab.

G. Stanford. Journal of Environmental Quality, Vol 2, No 2, p 159-166, April-June, 1973. 5 fig, 1 tab, 27 ref.

Descriptors: \*Fertilizers, \*Fertilization, Fertility, Nutrient removal, Leaching, \*Nitrogen, Nitrates, Denitrification, Water pollution sources, Groundwater, \*Corn(Field), Optimum development plans.

During the past decade, the percentage of the corn acreage in the USA receiving N fertilizer has risen steadily. By 1971, in the Corn Belt and five adjoining states, this proportion ranged from 93 to 100% of the total corn acreage. Between 1964 and 1970 the average rate of N applied to fertilized acres increased about 83% in the Corn Belt and 128% in adjacent states (Nebraska, Kansas, Michigan, Wisconsin, and Minnesota). Undoubtedly, there has been an accompanying increase in the proportion of the corn acreage receiving optimum to excessive amounts of N fertilizer. These trends emphasize the importance of developing improved procedures for achieving optimum fertilizer N use (i.e., adequate but not excessive rates, and proper timing for greater efficiency) consistent with the goal of minimizing the possibility of environmental pollution. (Skogerboe-Colorado State)  
W74-08929

## WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

### Conservation In Agriculture—Group 3F

#### DYNAMIC SIMULATION OF AUTOMATED SUBSURFACE IRRIGATION SYSTEMS,

Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.  
C. H. M. van Bavel, J. Ahmed, S. I. Bhuiyan, E. A. Hiler, and A. G. Smajstrla.  
Transactions of the ASAE (American Society of Agricultural Engineers), Vol 16, No 6, p 1095-1099, November-December, 1973. 6 fig, 1 tab, 6 ref.

Descriptors: \*Irrigation practices, \*Subsurface irrigation, \*Automation, Computer models, Mathematical models, Soil moisture, Soil water, Soil water movement, \*Simulation analysis, \*Water distribution(Applied), \*Water delivery.

Water delivery and distribution from a subsurface irrigation system were simulated for a simplified one-dimensional case. Water loss by surface evaporation and root uptake was taken into account in a manner reflecting its dependence upon depth and time of day. The system was defined as an automatic one, in which the water content at a given depth would turn infiltration from the buried delivery system off and on. The simulation was performed in S/360 CSMP, a dynamic simulation language that appears well adapted for this type of problem. The program is efficient and allows ready substitution of the hydraulic characteristics of the soil, the consumptive use pattern, and the root uptake distribution with depth, as well as geometrical variables. The results that in a Yolo clay loam and with a typical consumptive use and root distribution pattern, an automated system will cycle from a delivery period of about 2 hours through a redistribution period of about 40 hours, while maintaining an essentially constant water content in the root zone, provided the depth of delivery and control are properly chosen. (Skogerboe-Colorado State)  
W74-08931

#### FURROW IRRIGATION CRITERIA FOR HAWAIIAN SUGARCANE,

Hawaiian Sugar Planters' Association Experiment Station, Honolulu.  
C. M. Vaziri, H. G. Collins, and W. N. Reynolds.  
Journal of the Irrigation and Drainage Division, American Society of Civil Engineers, Vol 99, No IR1, p 1-14, March, 1973. 4 fig, 3 tab, 3 ref.

Descriptors: Irrigation, \*Irrigation practices, \*Furrow irrigation, \*Hawaii, Hydraulics, \*Infiltration, \*Sugarcane, Water distribution(Applied), Water control.

Empirical equations describing infiltration, advance, recession, and opportunity time for infiltration were developed by analysis of inflow-outflow-time measurements recorded during furrow irrigation of sugarcane. The measurements represent field conditions at various sugarcane ages on the Molokai soil series. A concept of relating furrow infiltration as a function of furrow length is presented. The development of equations and tables for use in the design and efficient operation of sugarcane furrow irrigation systems in the Hawaiian Islands is described. (Skogerboe-Colorado State)  
W74-08932

#### SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, TAOS COUNTY,

New Mexico State Univ., University Park. Dept. of Agronomy.  
H. J. Maker, J. J. Folks, and J. U. Anderson.  
Available from the National Technical Information Service as PB-233 119, \$3.25 in paper copy, \$1.45 in microfiche. Agricultural Experiment Station Research Report 268, New Mexico State University, Las Cruces, New Mexico, 1974. 44 p, 8 fig, 7 tab, 8 ref. OWRR B-015-NMEX(24).

Descriptors: \*New Mexico, \*Irrigable land, \*Soil classification, \*Land classification, Soil investigations, Agriculture, Irrigation.

Identifiers: \*Taos County(N. Mex.), \*Soil associations, \*Irrigation potential, Soil interpretation, Soil characteristics, Soil description.

Information is presented on the suitability of soils in Taos County, New Mexico for irrigation. The acreage, general location, and relative capability of the soils for use in irrigated agriculture are given. The general soil map and a detailed soil survey provided the information necessary for the classification for irrigation. The data were organized and presented on the basis of soil associations shown on the general soil map and on the irrigation land classification map. Taos County has about 1,444,500 acres, of which about 29 percent were considered suitable for irrigation. About 33,600 acres were in irrigation class 1; 200,442 acres in class 2; 136,968 acres in class 3; and 55,044 acres in class 4. The remaining 1,018,446 acres in the county were in land class 6, which was not considered suitable for irrigation. Information also is provided on soil resources that can be used for preliminary planning for irrigated agriculture, forestry, range, urban, engineering, recreation, and wildlife uses. A general soil map and a classification of land for irrigation map, both in color are included. (Hain-New Mexico State)  
W74-09054

#### SUITABILITY OF NEW MEXICO LANDS FOR IRRIGATION,

New Mexico State Univ., University Park. Dept. of Agronomy.  
J. U. Anderson, and H. J. Maker.  
Available from the National Technical Information Service as PB-233 122, \$3.25 in paper copy, \$1.45 in microfiche. Agricultural Experiment Station Research Report 276, New Mexico State University, Las Cruces, New Mexico, 1974. 28 p, 12 fig, 1 tab, 5 ref. OWRR B-015-NMEX(25).

Descriptors: \*New Mexico, \*Irrigable land, Soil classification, Land classification, Soil investigation, Agriculture, Irrigation.  
Identifiers: \*Soil associations, \*Irrigation potential, Soil interpretation, Soil characteristics, Soil description.

Results are summarized of a study which was conducted to obtain the extent, nature, and distribution of irrigable land in New Mexico. Irrigation land classes were assigned to soils on the basis of data obtained from various published and unpublished detailed and reconnaissance soil surveys. The data were organized and presented on the basis of soil associations. New Mexico has about 77,866,400 acres, of which about 41 percent were considered suitable for irrigation. About 3,799,809 (5%) acres were in irrigation class 1; 10,167,058 (13%) acres in class 2; 11,030,216 (14%) acres in class 3; 6,827,297 (9%) acres in class 4. The remaining 46,042,020 acres in the state were in land class 6, which was not considered suitable for irrigation. These figures are in contrast to the 1.5 percent of the state now being irrigated. Information is provided on soil resources to be used for preliminary planning for irrigated agriculture, forestry, range, urban, engineering, recreation and wildlife use. A general suitability map prepared from the county irrigation land classification maps of the 31 county reports previously published is included. (Hain-New Mexico State)  
W74-09055

#### SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, MCKINLEY COUNTY,

New Mexico State Univ., University Park. Dept. of Agronomy.  
H. J. Maker, H. E. Bullock, Jr., and J. U. Anderson.  
Available from the National Technical Information Service as PB-233 121, \$3.75 in paper copy, \$1.45 in microfiche. Agricultural Experiment Station, Research Report 262, New Mexico State University, Las Cruces, New Mexico, 1974. 68 p, 13 fig, 7 tab, 8 ref. OWRR B-015-NMEX(22).

Descriptors: \*New Mexico, \*Irrigable land, \*Soil classification, \*Land classification, Soil investigations, Agriculture, Irrigation.

Identifiers: \*McKinley County(N. Mex.), \*Soil associations, \*Irrigation potential, Soil interpretation, Soil characteristics, Soil description.

Information is presented on the suitability of soils in McKinley County, New Mexico for irrigation. The acreage, general location, and relative capability of the soils for use in irrigated agriculture are given. The general soil map based on a reconnaissance soil survey and limited detailed soil surveys provided the information necessary for the classification for irrigation. The data were organized and presented on the basis of soil associations shown on the general soil map and on the irrigation land classification map. McKinley County has about 3,495,000 acres, of which about 42 percent were considered suitable for irrigation. About 86,553 acres were in irrigation class 1; 410,917 acres in class 2; 298,331 acres in class 3; and 654,910 acres in class 4. The remaining 2,044,289 acres in the county were in land class 6, which was not considered suitable for irrigation. Information is also provided on soil resources that can be used for preliminary planning for irrigated agriculture, forestry, range, urban, engineering, recreation, and wildlife uses. A general soil map and a classification of land for irrigation map, both in color, are included. (Hain-New Mexico State)  
W74-09056

#### SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, VALENCIA COUNTY,

New Mexico State Univ., University Park. Dept. of Agronomy.  
H. J. Maker, C. W. Keetch, and J. U. Anderson.  
Available from the National Technical Information Service as PB-233 120, \$3.75 in paper copy, \$1.45 in microfiche. Agricultural Experiment Station Research Report 267, New Mexico State University, Las Cruces, New Mexico, 1974. 72 p, 13 fig, 7 tab, 11 ref. OWRR B-015-NMEX(23).

Descriptors: \*New Mexico, \*Irrigable land, \*Soil classification, \*Land classification, Soil investigations, Agriculture, Irrigation.  
Identifiers: \*Valencia County(N. Mex.), \*Soil associations, \*Irrigation potential, Soil interpretation, Soil characteristics, Soil description.

Information is presented on the suitability of soils in Valencia County, New Mexico for irrigation. The acreage, general location, and relative capability of the soils for use in irrigated agriculture are given. The general soil map based on a reconnaissance soil survey and limited detailed soil surveys provided the information necessary for the classification for irrigation. The data were organized and presented on the basis of soil associations shown on the general soil map and on the irrigation land classification map. Valencia County has about 3,621,000 acres, of which about 38 percent were considered suitable for irrigation. About 75,357 acres were in irrigation class 1; 477,008 acres in class 2; 531,389 acres in class 3; and 305,140 acres in class 4. The remaining 2,232,206 acres in the county were in land class 6, which was not considered suitable for irrigation. Information also is provided on soil resources that can be used for preliminary planning for irrigated agriculture, forestry, range, urban, engineering, recreation, and wildlife uses. A general soil map and a classification of land for irrigation map, both in color, are included. (Hain-New Mexico State)  
W74-09057

#### SOIL AND WATER CONSERVATION.

For primary bibliographic entry see Field 6E.  
W74-09169

## Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

### Group 3F—Conservation In Agriculture

#### PROSPECTIVE COSTS OF ADJUSTING TO A DECLINING WATER SUPPLY: TEXAS HIGH PLAINS.

Economic Research Service, (USDA), Washington, D.C.  
For primary bibliographic entry see Field 6D.  
W74-09242

#### EFFECTS OF VARIOUS WATER REGIMES ON STOMATAL AND MESOPHYLL CONDUCTANCES OF BEAN LEAVES.

Akademiya Nauk Estonskoi SSR, Tartu. Institut Fiziki i Astronomii.

H. Moldau.  
Photosynthetica (Prague). Vol 7, No 1, p 1-7, 1973. Illus.

Identifiers: \*Bean leaves, Defoliation, \*Desiccation, Leaves, \*Mesophyll conductances, Phaseolus-vulgaris, \*Stomatal conductances, Soil flooding.

Soil-grown bean plants (*Phaseolus vulgaris* L.) were subjected to rewetting after desiccation, partial defoliation and flooding. Subsequent responses of the conductances of the stomata and of the mesophyll were studied in a conditioned leaf chamber under a saturating illuminance and a limiting CO<sub>2</sub>-supply. The mesophyll conductance remained constant during 4 days of desiccation to -13 bar and during the recovery of the leaf water potential from -13 to -5 bar. Changes in the photosynthetic activity of leaves were solely attributed to changes in the stomatal conductance. Defoliation of a well-watered plant caused no changes in both conductances of the remaining leaves. Defoliation of a desiccated plant resulted in an increase in the stomatal conductance, with the mesophyll conductance remaining constant. Flooding of the soil caused a sharp decrease in both conductances. It is concluded that soil-induced changes of the water deficit of leaves cause no changes in the mesophyll conductance over the whole range of leaf water potentials where stomata usually operate. Flooding of the root system probably brings about an insufficient supply of metabolites (needed for the normal course of the carboxylation reaction) from roots to leaves. Copyright 1974, Biological Abstracts, Inc.  
W74-09247

#### WATER LOSS FROM AN IRRIGATED SORGHUM FIELD: I. WATER FLUX WITHIN AND BELOW THE ROOT ZONE.

South Dakota State Univ., Brookings. Dept. of Plant Science.  
L. R. Stone, M. L. Horton, and T. C. Olson.  
Agronomy Journal, Vol 65, No 3, p 492-495, May-June, 1973. 5 fig, 1 tab, 6 ref. OWRR A-018-SDAK(4).

Descriptors: \*Soil water, \*Soil moisture, \*Leaching, Tensiometers, Hydraulic gradient, Hydraulic conductivity, \*Sorghum, Irrigation.

Water movement within and below the root zone of a sorghum crop was evaluated during a 31-day field study following water application. Hydraulic potential data from tensiometers placed at eight depths in the soil profile were used to determine the hydraulic gradients. Soil water flux in various depth layers was calculated using the hydraulic potential gradients and the determined hydraulic conductivity vs soil water content relationships. Upward water movement commenced in the 15 to 30 cm layer 3 days following water application and 130 to 150 cm layer after 19 days. The upward water flux into the root reached a maximum of approximately 0.2 cm/day near the end of the study period. During the 31-day study period, 6.0 cm of water were lost from the 150 cm soil profile by flux below the root zone. This illustrates the importance of considering water loss due to flux below the root zone in crop situations. (See also W74-09249) (Skogerboe-Colorado State)  
W74-09248

#### WATER LOSS FROM AN IRRIGATED SORGHUM FIELD: II. EVAPOTRANSPIRATION AND ROOT EXTRACTION.

South Dakota State Univ., Brookings. Dept. of Plant Science.  
L. R. Stone, M. L. Horton, and T. C. Olson.  
Agronomy Journal, Vol 65, No 3, p 495-497, May-June, 1973. 5 fig, 9 ref. OWRR A-018-SDAK(5).

Descriptors: \*Drainage, \*Evapotranspiration, \*Deep percolation, Soil water, Soil moisture, Tensiometers, Soil water movement, \*Sorghum, Irrigation.

A method using tensiometers for obtaining evapotranspiration rates and root extraction patterns within an actively growing sorghum crop is discussed. Profile water depletion was calculated from water content profiles determined using tensiometer readings and laboratory-measured soil water characteristics. Profile water depletion minus flux below the root zone yielded the daily evapotranspiration rate. During the 31-day study, approximately 65% of the total water loss was due to flux loss from the root zone. These data clearly show the importance of considering flux below the root zone when attempting to determine evapotranspiration rates using depletion methods. The method of determining evapotranspiration rates illustrated provides an alternative to the microclimatological and lysimeter methods. (See also W74-09248) (Skogerboe-Colorado State)  
W74-09249

## 4. WATER QUANTITY MANAGEMENT AND CONTROL

### 4A. Control Of Water On The Surface

#### ECOLOGICAL EQUILIBRIUM OF RIVER-ESTUARY-SEA SYSTEMS AND IMPROVEMENT OF THEIR EFFICIENCY FOR THE NATIONAL ECONOMY (O EKOLOGICHESKOM RAVNOVESII SISTEM REKA-LIMAN-MORE I POVYSHENII IKH NARODNOKHOZYAYSTVENNOY EFFEKTIVNOSTI).

Akademiya Nauk URSS, Odessa. Institut Ekonomiki.  
For primary bibliographic entry see Field 2L.  
W74-08708

#### FORECASTING CHANGES IN WATER BALANCE UNDER INFLUENCE OF HUMAN ACTIVITY (PROGNOZIROVANIYE IZMENENIY VODNOGO BALANSA POD VLIYANIYEM KHOZYAYSTVENNOY DEYATEL'NOSTI).

A. G. Bulavko.  
Vodnyye Resursy, No 4, p 50-58, 1973. 1 fig, 3 tab, 20 ref.

Descriptors: \*Forecasting, \*Future planning(Projected), \*Water balance, \*Human population, Watershed management, Forest management, Land management, Soil management, Land reclamation, Drainage practices, Reservoir construction, Agriculture, Crop production, Runoff, Evaporation.  
Identifiers: \*USSR(Belourussia).

A forecast of changes in water-balance items in Belourussia resulting from man's activities in watersheds was prepared on the basis of projected plans of development of agricultural production and land reclamation in the Republic. Four types of human activity are considered: (1) changes in forested and plowed areas, (2) intensification of agriculture, (3) drainage practices such as reclamation of bogs and waterlogged soils, and (4) construction of reservoirs. Present streamflow data can be used in planning for water-resources

development, since no significant changes are anticipated in the structure of the water balance or in the value and seasonal distribution of runoff in the next 10-15 years. (Josefson-USGS)  
W74-08709

#### MAN-MADE LAKES: THEIR PROBLEMS AND ENVIRONMENTAL EFFECTS.

W. C. Ackermann, G. F. White, E. E. Worthington, and J. L. Ivens.  
American Geophysical Union, Washington, D.C. Geophysical Monograph 17, 1973. 847 p.

Descriptors: \*Environmental effects, \*Artificial lakes, \*Multiple-purpose reservoirs, \*Lake morphology, Limnology, Hydraulics, Hydrology, Impoundments, Social aspects, Recreation, Africa, Sedimentation, \*Aquatic environment.

Presented in this volume are 113 technical papers given at the third International Symposium on Man-Made Lakes, held in Knoxville, Tennessee, in 1971, organized by the International Council of Scientific Unions. Topics were divided into sessions covering opportunities and environmental effects, Man-made lakes of the world. Case studies of major artificial lakes, Reservoirs as physical systems, Limnology and biological systems, Reservoirs in relation to man, and Management for multiple use. Questions addressed were how man-made lakes differ from natural lakes and from place to place, and how man functions as a part of the new ecosystem as it goes through its several stages of development. There is emphasis on African lakes such as Kainji, Volta, Kariba, and Nasser. A comprehensive summary and recommendations section synthesizes the complex relationships and choices by the participants, and offers a number of guidelines designed to be useful in future decisions relating to this method of altering the natural ecosystem. (See W74-08748 thru W74-08752) (Paylore-Arizona)  
W74-08747

#### LAKE MEAD, A CASE HISTORY.

Bureau of Reclamation, Denver, Colo.  
D. A. Hoffman, and A. R. Jonez.  
In: Man-Made Lakes: Their Problems and Environmental Effects, Geophysical Monograph 17, American Geophysical Union, Wash. D.C., 1973. W. C. Ackermann, G. F. White, and B. Worthington, editors, p 220-233, 9 fig, 1 tab, 1 append. 15 ref.

Descriptors: \*Density currents, \*Sedimentation, \*Ecosystems, \*Colorado River Basin, Dams, Lake morphology, Geologic history, Arid lands, Water quality, Earthquakes, Climatology, Limnology, Hydrology, Hunting, Fishing, Recreation, \*Arizona, \*Nevada, Stratification.

Identifiers: \*Lake Mead, Hoover Dam, Lake Powell, Las Vegas Wash, Black Canyon, Lake Mead National Recreation Area, Virgin River basin.

A history of Lake Mead, formed by Hoover Dam in the arid Black Canyon of the Colorado River is presented. Subjects include geologic aspects, limnology, ecology, hydrology, history of man in the area, and recreation. Research is needed in the biology and ecology of the reservoir: circulation patterns in relation to Lake Powell; the cause of regime of low dissolved oxygen layers during stratification; and the effect of development in the Las Vegas Wash and Virgin River basins on water quality of Lake Mead. (See also W74-08747) (Mastic-Arizona)  
W74-08748

#### LAKE NASSER.

Lake Nasser Development Centre, Aswan, (Egypt).  
P. C. Raheja.  
In: Man-Made Lakes: Their Problems and Environmental Effects, Geophysical Monograph 17,

## WATER QUANTITY MANAGEMENT AND CONTROL—Field 4

### Control Of Water On The Surface—Group 4A

Amer. Geophysical Union, Washington, D.C., 1973. W. C. Ackermann, G. F. White, and E. B. Worthington, editors, p 234-245, 3 fig, 1 tab.

Descriptors: \*Aquatic environment, \*Multiple-purpose reservoirs, \*Lake morphology, Limnology, Meteorology, Ecosystems, Fisheries, Irrigation, Transportation, Tourism, Locks.  
Identifiers: \*Aswan High Dam, \*Lake Nasser, \*U.A.R.(Egypt).

Knowledge, development problems, and opportunities are summarized for Lake Nasser reservoir impounded by the Aswan High Dam in Egypt. Highlights include descriptions of physical data, the biological system, and the relationship to man's activities, including the fishing industry, agriculture, transportation, tourism, public health, and scientific activities an economic analysis summary is presented of pre-investment for multiple-use management and development of resources. (See also W74-08747) (Mastic-Arizona)  
W74-08749

#### SEEPAGE LOSSES FROM LAKE NASSER,

High Dam Authority, Cairo (Egypt).  
T. A. Wafa, and A. H. Labib.  
In: Man-Made Lakes: Their Problems and Environmental Effects, Geophysical Monograph 17, Amer. Geophysical Union, Washington, D.C., 1973. W. C. Ackermann, G. F. White, and E. B. Worthington, editors, p 287-291, 2 tab.

Descriptors: \*Seepage, \*Water level recorders, \*Boreholes, Seepage control, \*Porosity, Permeability, Aquifers, Reservoirs, Sandstones, Evaporation, Faults(Geologic), Groundwater, Piezometers, Bank Storage, Water table, Hydraulic gradient, Outlets, Inlets(Waterways).  
Identifiers: \*Aswan High Dam, \*Lake Nasser, \*U.A.R.(Egypt).

Before the construction of the Aswan High Dam forming Lake Nasser, average seepage losses were estimated to be 1000 million cu/m per year. Following construction, investigations were undertaken to confirm or correct the estimate. In total, 29 shallow bore holes and 5 deep research bore holes were drilled, of which 23 of the shallow and all the deep bore holes were completed as piezometers and were equipped with automatic water level recorders. Results showed the porosity of the overall bedding to be approximately 25 percent. Evidence of at least two groundwater aquifers in the Nubian sandstone was found, but only the upper unconfined aquifer is affected by the riverbed, while the deep confined aquifer is recharged mainly from the Eastern Desert. Investigations also showed that water seeping from the banks of the Nile below the Dam is the result of seepage loss along the banks of the reservoir. The expected seepage losses appear to have been reasonably estimated, based on present data, but studies are being continued, particularly the monitoring of flow at the inlet and outlet. (See also W74-08747) (Mastic-Arizona)  
W74-08750

#### FALL AND RISE OF LAGO DEL ORO,

Dept. of Civil Engineering, Knoxville. Tennessee Univ.,  
R. L. A. De Jong.  
In: Man-Made Lakes: Their Problems and Environmental Effects, Geophysical Monograph 17, American Geophysical Union, Washington, D.C., 1973. W. C. Ackermann, G. F. White, and E. B. Worthington, editors, p 292-294.

Descriptors: \*Dam design, \*Soil mechanics, \*Reservoir construction, \*Reservoir leakage, \*Project post-evaluation, Runoff, Streambeds, Recreation seepage, Spillways, Grouting, Slurries, Sealants, Impoundments, \*Arizona.

Water-holding problems were studied in the Lago Del Oro reservoir near Tucson, Arizona.

Hydrologic observations showed evidence of excess seepage. Further investigations showed that problems stemmed from inadequate clay core depth, a poor seal between upper and lower clay core sections, and on one side of the reservoir bottom, conglomerate containing several old buried stream channels with occasional outcroppings in the reservoir bottom. A number of corrective measures were tested including clay slurry, chemical sealants, grouting, modification of soil distribution in the reservoir, and a clay blanket. A combination of the last two has been the most economical dependable measure. Problems encountered point out the need for comprehensive studies prior to construction of dam and reservoir projects. (See also W74-08747) (Mastic-Arizona)  
W74-08751

#### ECOSYSTEM OF THE SALTON SEA,

California State Univ., Long Beach. Dept. of Microbiology.  
J. Kim.

In: Man-Made Lakes: Their Problems and Environmental Effects, Geophysical Monograph 17, American Geophysical Union, Washington D.C., 1973. W. C. Ackermann, G. F. White, and E. B. Worthington, editors, p 601-605, 14 ref.

Descriptors: \*Saline lakes, \*Salinity, \*Water pollution sources, \*Agricultural chemicals, Marine microorganisms, Salts, Halophilic animals, Fish, Population, Pollutants, Algae, Plankton, Nutrients, Marine bacteria, Irrigation canals, Desalination, Chlorides, Sinks, Hydrogen ion concentration, \*California, Ecosystems.  
Identifiers: \*Salton Sea.

The ecosystem of the Salton Sea, a saline lake in southeastern California, is threatened with destruction as a result of increasing salinity and pollution of the lake. Having no outlet, the Salton Sea is a sink collecting large amounts of treated and untreated sewage from surrounding communities, agricultural chemicals and fertilizers, and natural drainage water containing nutrients and salts which are left in residual form. Chlorosities will reach the critical range for fishery and water contact sports by 1980. Each year a sudden massive die-off of millions of fish occurs due principally to toxic algae poisoning. Recommendations are cited, but emphasis is on the need to control the inflow of sewage and agriculture chemicals particularly, in addition to control of increasing salinity. (See also W74-08747) (Mastic-Arizona)  
W74-08752

#### PREDICTING THE HYDROLOGIC EFFECTS OF LAND MODIFICATIONS,

Arizona Univ., Tucson.  
M. M. Fogel, L. Duckstein, and C. C. Kisiel.  
Paper no. 73-250 for presentation at 1973 meeting of American Society of Agricultural Engineers, University of Kentucky, Lexington, June 17-20, 1973. 14 p, 5 fig, 1 tab, 22 ref. OWRR B-032-ARIZ (5).

Descriptors: \*Forecasting, \*Stochastic processes, \*Peak discharge, \*Hydrologic data, \*Simulation analysis, Water yield, Sediment yield, Watershed management, Precipitation(Atmospheric), Evaporation, Small watersheds, Storm runoff, Unit hydrographs.  
Identifiers: Hydrologic forecasting.

A methodology that can be used to predict long-term hydrologic effects of land modifications on ungauged watersheds is presented. An event-based stochastic model of precipitation provides input into a deterministic watershed model that transforms the inputs into desired hydrologic data such as water yield, peak runoff rate, and sediment yield. The Soil Conservation Service method is used to transform rainfall into runoff. On a large scale, the procedure can be used to determine watershed treatment effects on the optimum size of a floodwater retarding structure. The model is

designed to reduce uncertainties in the current practice of implying that rainfall and runoff have similar frequency distributions. The model also provides flexibility in that elevation effects can be accounted for, the distribution function of mean areal rainfall can be utilized, the probability density function of runoff can be obtained, and simultaneous synthetic sets of rainfall, runoff, and soil moisture can be generated for more detailed hydrologic investigations. (Mastic-Arizona)  
W74-08753

#### THE RELEASE OF WATER FROM FOREST SNOWPACKS DURING WINTER,

Forest Service (USDA), Ogden, Utah. Intermountain Forest and Range Experiment Station.  
For primary bibliographic entry see Field 2C.  
W74-08761

#### TYPES OF IRRIGATION SYSTEMS,

North Carolina State Univ., Raleigh. Dept. of Biological and Agricultural Engineering.  
For primary bibliographic entry see Field 3F.  
W74-08800

#### 1973 IRRIGATION SURVEY.

For primary bibliographic entry see Field 3F.  
W74-08817

#### CONTROLLED SPRINKLER IRRIGATION SYSTEM FOR EQUALIZED WATER DISTRIBUTION DEVELOPED IN ISRAEL.

For primary bibliographic entry see Field 3F.  
W74-08818

#### PROMOTING ENVIRONMENTAL QUALITY THROUGH URBAN PLANNING AND CONTROLS,

North Carolina Univ., Chapel Hill. Center for Urban and Regional Studies.  
For primary bibliographic entry see Field 5G.  
W74-08828

#### CONTROLLED INSTANTANEOUS APPLICATION OF FREE WATER TO A POROUS SURFACE,

Purdue Univ., Lafayette, Ind. Dept. of Agronomy.  
For primary bibliographic entry see Field 2G.  
W74-08883

#### DEVELOPMENT AND FUTURE OF DREDGING,

Corps of Engineers, Atlanta, Ga. South Atlantic Div.  
For primary bibliographic entry see Field 5G.  
W74-08893

#### FLOW TOWARD PERIODIC TITLE DRAINS,

Wisconsin Univ., Milwaukee. School of Architecture.  
For primary bibliographic entry see Field 2F.  
W74-08923

#### WATER LAW AND THE HYDROLOGIC CYCLE: A TEXAS EXAMPLE,

Texas Tech Univ., Lubbock. Dept. of Geography.  
For primary bibliographic entry see Field 6E.  
W74-08930

#### DYNAMIC SIMULATION OF AUTOMATED SUBSURFACE IRRIGATION SYSTEMS,

Texas A and M Univ., College Station. Dept. of Soil and Crop Sciences.  
For primary bibliographic entry see Field 3F.  
W74-08931

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4A—Control Of Water On The Surface

**FURROW IRRIGATION CRITERIA FOR HAWAIIAN SUGARCANE**, Hawaiian Sugar Planters' Association Experiment Station, Honolulu.  
For primary bibliographic entry see Field 3F.  
W74-08932

**THE DEMOGRAPHIC, POLITICAL, AND ADMINISTRATIVE SETTING**, Florida Univ., Gainesville. Urban Studies Bureau.  
For primary bibliographic entry see Field 6B.  
W74-09058

**HYDROGRAPHY AND BEACH DYNAMICS**, Rosenstiel School of Marine and Atmospheric Science, Miami, Fla.  
For primary bibliographic entry see Field 6B.  
W74-09059

**PROBLEMS OF THE REGIME AND INVESTIGATION OF LAKES AND RESERVOIRS (VOPROSY REZHIMA I ISSLEDOVANIYA OZER I VODOKHRANILISHCH)**, Gosudarstvennyi Gidrologicheskii Institut, Leningrad (USSR).  
For primary bibliographic entry see Field 2H.  
W74-09100

**THE UPPER HUDSON WHITEWATER OR WASHWATER**,  
For primary bibliographic entry see Field 6D.  
W74-09137

**LITTLE CALUMET RIVER FLOOD CONTROL COORDINATING COMMISSION**,  
For primary bibliographic entry see Field 6E.  
W74-09144

**PROTECTION AND IMPROVEMENT OF WATERS**,  
For primary bibliographic entry see Field 6E.  
W74-09149

**NATURAL AND SCENIC RIVERS SYSTEM**,  
For primary bibliographic entry see Field 6E.  
W74-09150

**WHAT CONSTITUTES PUBLIC WATERWAYS AND RIGHTS**,  
For primary bibliographic entry see Field 6E.  
W74-09151

**DIVERSION OF WATER**,  
For primary bibliographic entry see Field 6E.  
W74-09155

**SOME NEW METHODS OF TOPOLOGIC CLASSIFICATION OF CHANNEL NETWORKS**, IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y.  
For primary bibliographic entry see Field 8B.  
W74-09221

**THE BIRCHWOODS OF MONTANE DAGESTAN (IN RUSSIAN)**, Dagestanskii Gosudarstvennyi Universitet, Mak-hachkala (USSR).  
P. L. L'Vov.  
Bot Zh. Vol 58, No 1, p 106-113, 1973.  
Identifiers: Alder, Birch, \*Birchwoods, Conservation, \*Montane regions, Oak, Rhododendron-luteum, \*USSR(Dagestan-montane).

Species composition of mixed and pure birchwoods was studied in the 3 geomorphological regions of Dagestan (Russian SFSR, USSR): intramontane, extramontane and high mountain.

Only in the high mountain region is the subalpine forest zone clearly defined, characterized by successively alternating subalpine sparse woods and subalpine dwarf shrubs. In intermontane Dagestan, the subalpine forest zone is characterized only by sparse birchwoods, while in the extramontane regions, by birch, oak, occasionally alder, and thickets of Rhododendron luteum. These differences are related to characteristics of each geomorphological region (altitude above sea level, presence or absence of glaciers, amount of precipitation, rock composition). In addition, in all 3 regions, subalpine elements dominated in the grassy covering of the birch groves. The birchwoods of Dagestan play an important role in preventing soil erosion, affect mountain streams, are economically valuable and must therefore be protected from exploitation.--Copyright 1974, Biological Abstracts, Inc.  
W74-09232

### 4B. Groundwater Management

**ESTIMATION AND MAPPING OF RATES OF EXCHANGE OF FRESH GROUNDWATER IN THE BALTIC ARTESIAN BASIN (OTSENKA I KARTIROVANIYE TEMPOV VODOOBMEENA PRESNYKH PODZEMNYKH VOD (NA PRIMERE PRIBALTIYSKOGO ARTEZIAN-SKOGO BASSEYNA))**, Akademiya Nauk SSSR, Moscow. Institut Vodykh Problem.  
For primary bibliographic entry see Field 2F.  
W74-08705

**SEEPAGE LOSSES FROM LAKE NASSER**, High Dam Authority, Cairo (Egypt).  
For primary bibliographic entry see Field 4A.  
W74-08750

**GROUNDWATER RECHARGE FROM A PORTION OF THE SANTA CATALINA MOUNTAINS**, Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering.  
For primary bibliographic entry see Field 2F.  
W74-08764

**COMPETITIVE GROUNDWATER USAGE FROM THE NAVAJO SANDSTONE**, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.  
F. H. Dove, and T. G. Roefs.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proc. of the 1973 meetings of the Arizona Section-AWRA, and the Hydrology Section-Arizona Academy of Science, May 4-5, 1973, Tucson, Arizona, p 124-135, (1973). 3 fig, 3 tab, 10 ref.

Descriptors: \*Groundwater, \*Pumping, \*Computer models, Aquifers, Wells, \*Sandstones, \*Drawdown, Water table, Hydraulic conductivity, Artesian aquifers, Groundwater recharge, Potentiometric level, Artesian head, \*Arizona, Simulation analysis.  
Identifiers: \*Navajo Sandstone groundwater(Ariz), Slurry pumping.

Computer modeling of the Navajo Sandstone groundwater system is used to determine the relationship between mining pumping and declines in the potentiometric surface at locations within the Navajo and Hopi Indian communities. The computer simulation developed is a modified version of the basic artesian aquifer routine used by the Illinois State Water Survey. Assuming no abnormal leakage paths, mining usage will not appreciably affect Indian wells located in the Mesa-verde formation. Theoretical drawdown estimates can be made for locations in the artesian and unconfined areas of the Navajo Sandstone. The drawdowns vary from zero to less than 20 percent of the arte-

sian head elevation above the Navajo Sandstone formation in confined areas. (Mastic-Arizona)  
W74-08768

**NORTHERN ILLINOIS USES STORAGE EFFECTIVELY**, D. P. Fowler.  
Energy Pipelines and Systems, Vol 1, No 4, p 46-47, April, 1974.

Descriptors: \*Sand aquifers, \*Natural gas, \*Storage, \*Illinois.

The use of natural underground aquifers by the Northern Illinois Gas Co. for storage of natural gas is described. The aquifers are large, water bearing, dome shaped rock layers of porous sandstone. The sandstone spaces hold water much like gigantic sponges. Natural gas is pumped or injected into the sandstone at pressure great enough to push the water aside, and then downward. An overlying layer of impermeable caprock, usually shale or dense limestone keeps the gas from migrating to the surface. As more gas is injected, the shape of the dome provides the unique trapping mechanism. The aquifers deliver as much as 25% of the total gas sold during the winter, and as much as 55% of the gas distributed on an exceptionally cold day. (Merritt-FIRL)  
W74-08909

**UNSTEADY FLOW TO BOTTOM DRAIN IN BOUNDED AQUIFER**, Northwestern Univ., Evanston, Ill. Technological Inst.  
For primary bibliographic entry see Field 2F.  
W74-08926

**WATER LAW AND THE HYDROLOGIC CYCLE: A TEXAS EXAMPLE**, Texas Tech Univ., Lubbock. Dept. of Geography.  
For primary bibliographic entry see Field 6E.  
W74-08930

**GEOTHERMICS**,  
For primary bibliographic entry see Field 2F.  
W74-08973

**GEOHERMAL POTENTIAL OF IDAHO**, Idaho Bureau of Mines and Geology, Moscow.  
For primary bibliographic entry see Field 2F.  
W74-08974

**GEOHERMAL PROSPECTS IN NEW MEXICO**, New Mexico Bureau of Mines and Mineral Resources, Socorro.  
For primary bibliographic entry see Field 2F.  
W74-08975

**GEOHERMAL RESOURCES OF GUATEMALA, CENTRAL AMERICA**, Instituto Nacional de Electricidad (Guatemala).  
For primary bibliographic entry see Field 2F.  
W74-08976

**GEOHERMAL RESOURCES OF COSTA RICA**, Servicio Nacional de Electricidad, San Jose (Costa Rica).  
For primary bibliographic entry see Field 2F.  
W74-08977

**THERMAL AND MINERAL SPRINGS IN UGANDA**, Uganda Geological Survey and Mines Dept., Entebbe.  
For primary bibliographic entry see Field 2F.  
W74-08978

**GEOHERMAL RESOURCES IN TANZANIA,**  
Tanzania Mineral Resources Div., Dodoma.  
For primary bibliographic entry see Field 2F.  
W74-08979

**GEOHERMAL RESOURCES IN INDIA,**  
Central Water and Power Commission, New Delhi  
(India).  
For primary bibliographic entry see Field 2F.  
W74-08980

**A PROGRAM FOR THE EXPLORATION OF  
HIGH TEMPERATURE AREAS IN ICELAND,**  
National Engineering Authority, Reykjavik  
(Iceland).  
For primary bibliographic entry see Field 2F.  
W74-08981

**GEOHERMAL AREAS OF  
CZECHOSLOVAKIA,**  
Geoindustria, Prague (Czechoslovakia).  
For primary bibliographic entry see Field 2F.  
W74-08982

**GEOHERMAL EXPLORATION OF HOT  
WATER SOURCES IN THE CARPATHIANS OF  
YUGOSLAVIA AND CZECHOSLOVAKIA,**  
Sciintex Ltd., Concord (Ontario).  
For primary bibliographic entry see Field 2F.  
W74-08983

**THERMAL FIELDS OF THE EASTERN CAR-  
PATHIANS,**  
Akademiya Nauk URSR, Kiev. Institut Geofiziki.  
For primary bibliographic entry see Field 2F.  
W74-08984

**DEVELOPMENT OF RESEARCH AND  
UTILIZATION OF GEOHERMAL  
RESOURCES IN THE USSR,**  
Scientific Council on Geothermal Studies,  
Moscow (USSR).  
For primary bibliographic entry see Field 2F.  
W74-08985

**GEOHERMAL RESOURCES OF THE USSR  
AND PROSPECTS FOR THEIR PRACTICAL  
USE,**  
Akademiya Nauk SSSR, Moscow. Geologicheskii  
Institut.  
For primary bibliographic entry see Field 2F.  
W74-08986

**THERMAL WATERS OF GEORGIA,**  
Gruzinskii Politekhnikeskii Institut, Tiflis  
(USSR).  
For primary bibliographic entry see Field 2F.  
W74-08987

**UTILIZATION OF THERMAL WATERS FROM  
OIL DEPOSITS OF THE CAUCASUS,**  
Grozenskii Neftyanii Institut (USSR).  
G. M. Sukharev, S. P. Vlasova, and Y. K.  
Taranukha.  
In: Proceedings of the United Nations Symposium  
on the Development and Utilization of Geothermal  
Resources, Pisa, Italy, Sept 22-Oct 1, 1970:  
Geothermics 1970, Special Issue 2, Part 2, p 1102-  
1115, 1973, 10 fig, 5 ref.

Descriptors: \*Geothermal studies, \*Thermal  
water, Thermal springs, Hot springs, Hydrother-  
mal studies, Thermal power, Hydrogeology.  
Identifiers: \*Geothermal power, \*USSR(Caveasus).

During the exploitation of many gas-oil fields of  
the Caucasus a great quantity of thermal water is  
obtained. This water, with great economical ef-

fect, is sometimes used for hot water for industrial  
and agricultural enterprises and for heating com-  
mercial services. The development of Middle  
Miocene deposits over many years led to a con-  
siderable decrease of hydrodynamic levels and ex-  
pansion of cones of depressions for scores of  
kilometers. As a result of this there was reduction  
of yield and even exhaustion on many thermal  
springs. The most favorable conditions for  
development of the hydrodynamic system of the  
Black Mountains, Peredovoy ridges can be created  
by recovery and injection of 100,000 or 50,000 cu  
m of water per day. (See also W74-08973) (Knapp-  
USGS)  
W74-08988

**RECENT HYDROTHERMAL SYSTEMS OF  
KAMCHATKA,**  
Institut Vulkanologii, Petropavlovsk-Kamchatskii  
(USSR).  
For primary bibliographic entry see Field 2F.  
W74-08989

**GEOLOGY AND GEOHERMAL POWER  
POTENTIAL OF THE TATUN VOLCANIC RE-  
GION,**  
Mining Research and Service Organization, Taipei  
(Taiwan).  
For primary bibliographic entry see Field 2F.  
W74-08990

**RECENT PLANS OF GEOHERMAL EX-  
PLOITATION,**  
Japan Metals and Chemicals Co. Ltd., Morioka.  
Geothermal Power Div.  
For primary bibliographic entry see Field 2F.  
W74-08991

**EXPLOITATION OF THE MATSUKAWA  
GEOHERMAL AREA,**  
Japan Metals and Chemicals Co. Ltd., Morioka.  
Geothermal Power Div.  
For primary bibliographic entry see Field 2F.  
W74-08992

**THE GEOHERMAL SYSTEM OF THE  
KAKONE VOLCANO,**  
Hot Spring Research Inst. of Kanagawa Prefec-  
ture, Hakone (Japan).  
For primary bibliographic entry see Field 2F.  
W74-08993

**TYPES OF COMMERCIAL DEPOSITS OF  
THERMAL UNDERGROUND WATERS AND  
SOME VIEWS ON THE ASSESSMENT OF  
THEIR RESERVES,**  
Vsesoyuznyi Nauchno-Issledovatel'skii Institut  
Gidrogeologii i Inzhenernoi Geologii, Moscow  
(USSR).  
For primary bibliographic entry see Field 2F.  
W74-08994

**GEOHYDROLOGY OF THE LAUGARNES  
HYDROTHERMAL SYSTEM IN REYKJAVIK,  
ICELAND,**  
National Energy Authority, Reykjavik (Iceland).  
For primary bibliographic entry see Field 2F.  
W74-08996

**GEOPHYSICAL EXPLORATION THROUGH  
GEOLOGIC COVER,**  
For primary bibliographic entry see Field 2F.  
W74-09000

**GEOHERMAL PROSPECTING IN SHALLOW  
HOLES AND ITS LIMITATIONS,**  
Institute of Applied Geophysics, Prague  
(Czechoslovakia).  
For primary bibliographic entry see Field 2F.  
W74-09001

**TERRESTRIAL HEAT FLOW IN THE TERRI-  
TORY OF CZECHOSLOVAKIA AND THE MEAS-  
UREMENT OF THERMAL CONDUCTIVITY  
WITH FULLY-AUTOMATIC APPARATUS,**  
Ceskoslovenska Akademie Ved, Prague.  
Geofyzikalni Ustav.  
M. Kresl, and V. Novak.  
In: Proceedings of the United Nations Symposium  
on the Development and Utilization of Geothermal  
Resources, Pisa, Italy, Sept 22-Oct 1, 1970:  
Geothermics 1970, Special Issue 2, Vol 2, Part 2, p  
1261-1265, 1973, 4 fig, 2 tab, 10 ref.

Descriptors: \*Geothermal studies, \*Heat flow,  
\*Borehole geophysics, Thermal conductivity,  
Temperature, Instrumentation.  
Identifiers: \*Geothermal power, \*Czechoslovakia.

In Czechoslovakia geothermal measurements have  
been made since about 1964. A map of the heat  
flow on the territory of Czechoslovakia was made  
from more than 40 measurements in the boreholes.  
For measurement of the thermal conductivity on  
samples of rocks a fully automatic working ap-  
paratus was constructed. For direct measurements  
of the temperature gradient in boreholes a special  
probe 2 meters in length was designed, with a sen-  
sitivity of 0.01 deg C when measuring the gradient  
and 0.1 deg C when measuring the absolute tem-  
perature. (See also W74-08973) (Knapp-USGS)  
W74-09004

**GROUND SUBSIDENCE OF A GEOHERMAL  
FIELD DURING EXPLOITATION,**  
Ministry of Works, Wairakei (New Zealand).  
J. W. Hatton.

In: Proceedings of the United Nations Symposium  
on the Development and Utilization of Geothermal  
Resources, Pisa, Italy, Sept 22-Oct 1, 1970:  
Geothermics 1970, Special Issue 2, Vol 2, Part 2, p  
1294-1296, 1973, 3 fig.

Descriptors: \*Subsidence, \*Withdrawal,  
\*Hydrothermal studies, \*Geothermal studies,  
Thermal power, Water levels, Hydrogeology,  
Land subsidence.  
Identifiers: \*New Zealand, Geothermal power.

Ground subsidence in the geothermal field at  
Wairakei, New Zealand, was first measured in  
1956 when bench mark levels were compared with  
those established in 1950. The area affected by  
subsidence probably exceeds 25 square miles. The  
area of maximum subsidence occurs outside the  
production field. The present maximum sub-  
sidence rate in this area is 1.3 feet per annum.  
Some measurements of horizontal ground move-  
ment were made, and a relationship between this  
surface strain and vertical subsidence has been  
found. Exploitation of the Wairakei geothermal  
field has clearly been the major cause of the  
ground subsidence. At first, a simple relationship  
between subsidence and aquifer drawdown was  
evident, indicating elastic ground compression  
caused by a loss of buoyancy. In more recent  
years the ground has continued to subside despite  
a stabilizing of aquifer pressure. Although the re-  
gion of maximum subsidence occurs outside the  
production field, the steam transmission pipes and  
the main concrete hot water drain at Wairakei  
have been affected by the ground movement. (See  
also W74-08973) (Knapp-USGS)  
W74-09010

**PHOTOGRAMMETRIC TECHNIQUES AP-  
PLIED IN THE DEVELOPMENT OF GEOHER-  
MAL RESOURCES IN MATSUKAWA AND  
OTAKE GEOHERMAL AREAS USING A VEC-  
TOR METHOD,**  
International Geodetic Survey Inst. Co. Ltd.,  
Tokyo (Japan).  
N. Todoki.

In: Proceedings of the United Nations Symposium  
on the Development and Utilization of Geothermal  
Resources, Pisa, Italy, Sept 22-Oct 1, 1970:  
Geothermics 1970, Special Issue 2, Vol 2, Part 2, p  
1302-1309, 1973, 6 fig, 1 tab, 6 ref.

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4B—Groundwater Management

Descriptors: \*Photogrammetry, \*Aerial photography, \*Structural geology, Geothermal studies, Faults(Geologic), Terrain analysis, Stress, Strain. Identifiers: \*Japan, Geothermal power.

Many fracture zones are observed as linear features (photo-lineaments) in aero photographs. Photo-lineaments are translated and defined as character vector (C.V.). Using such procedures, the position and the depth of the geothermal reservoir in the Matsukawa and Otake areas of Japan were successfully determined. The geothermal zones are controlled by the C. V. oriented NE-SW and NS in Matsukawa area, and NE-SW, EW and NS in Otake, respectively. The distribution of resources shows the presence of various zonal harmonic periodicities. (See also W74-08973) (Knapp-USGS) W74-09012

#### CHEMISTRY IN THE EXPLORATION AND EXPLOITATION OF HYDROTHERMAL SYSTEMS.

Department of Scientific and Industrial Research, Wellington (New Zealand). Chemistry Div. For primary bibliographic entry see Field 2K. W74-09013

#### STATICAL INTERPRETATION OF CHEMICAL RESULTS FROM DRILLHOLES AS AN AID TO GEOTHERMAL PROSPECTING AND EXPLOITATION.

Department of Scientific and Industrial Research, Wellington (New Zealand).

In: Proceedings of the osium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1323-1339, 1973, 7 fig, 1 tab, 26 ref, append.

Descriptors: \*Geothermal studies, \*Hydrothermal studies, \*Geochemistry, \*Water chemistry, \*Statistical methods, Exploration, Heat flow, Thermal water, Mineral water, Boreholes, Thermal springs, Sampling.

Identifiers: \*Borehole geochemistry, \*New Zealand, Geothermal power.

In prospecting a geothermal field, it is necessary to allow a number of wells to discharge freely to test the potential of the field. Determinations of the concentrations of chloride and silica on water separated from the discharge at atmospheric pressure can be used to give information about the uniformity of the underground water. For this purpose, enthalpy should be plotted against chloride concentrations on paper with lines showing the effects on enthalpy and chloride of loss of steam, dilution, and loss of heat by conduction. When production wells are delivering separated steam to a steam line to the power station, samples of water separated at atmospheric pressure should be analyzed to give information on changes in the underground water supplies to the drillholes. Statistical studies with computer calculation of changes of chloride with time for groups of wells can give average yearly changes of enthalpy, which are much more accurate than changes found from direct enthalpy determinations and also give indications of the reasons for the changes. (See also W74-08973) (Knapp-USGS) W74-09014

#### THE BEHAVIOUR OF THE WAIRAKEI GEOTHERMAL FIELD DURING EXPLOITATION.

Ministry of Works, Wellington (New Zealand). R. S. Bolton.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1426-1439, 1973, 18 fig, 5 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data. Identifiers: \*Geothermal power, \*New Zealand.

Since the first bore discharged at Wairakei, New Zealand, in 1951, the total mass drawn from the field up to the middle of 1969 was 660,000,000 tons. Over this period, the rate of discharge has varied considerably from the gradual build up in the early years, to relatively sudden and substantial increases and decreases which have been imposed on the system from time to time. The Wairakei system consists basically of a highly permeable hot water aquifer contained within almost impermeable boundaries. Under exploitation, the dominant influence on the system is the saturation temperature pressure relationship for water, but the withdrawal of steam from the upper levels and the existence of a hot inflow at the lower levels have also played an important part. A satisfactory mathematical model having a predictive ability has not yet been formulated, but from a consideration of the past behavior, in general terms, the power output of the Wairakei station can be sustained at or near its present level for a number of years to come. (See also W74-08973) (Knapp-USGS) W74-09025

#### A STUDY OF THE RESERVOIR AT THE MATSUKAWA GEOTHERMAL FIELD.

Geological Survey of Japan, Kawasaki.

K. Baba, S. Takaki, G. Matsuo, and K. Katagiri.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1440-1447, 1973, 6 fig, 5 ref.

Descriptors: \*Geothermal studies, \*Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data. Identifiers: \*Geothermal power, \*Japan(Matsukawa).

The geothermal fluid reservoir of the Matsukawa geothermal field is below the Matsukawa andesite layer. Hot water and steam can be obtained from and below the lower part of dacite tuff layer, which lies beneath Matsukawa andesite. The lost circulation data during drilling often show the possible positions of a more permeable zone. Electric logging data give the clue to deduce whether the strata are permeable or not. Temperature logs obtained before discharging geothermal fluids often indicate the existence of a localized hot zone. In accordance with theory, some probable patterns of temperature and pressure near the well are shown, and their applications to the examples obtained at the wells of Matsukawa and its adjacent geothermal areas are discussed. (See also W74-08973) (Knapp-USGS) W74-09026

#### ESTIMATION OF HYDROTHERMAL SYSTEMS BY MEANS OF WELL-HEAD OBSERVATIONS.

National Research Center for Disaster Prevention, Tokyo (Japan).

K. Yuhara.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1458-1462, 1973, 4 fig, 2 tab, 8 ref.

Descriptors: \*Geothermal studies, Hydrothermal studies, \*Groundwater movement, Equations, Model studies, Thermal water, Drawdown, Water table, Boiling, Steam, Thermodynamics. Identifiers: \*Geothermal power.

Most geothermal steam originates from the underground boiling of groundwater. To find out the boiling conditions of thermal water in steam wells or reservoirs, a theoretical method is proposed. It can show the temperature, the pressure, the ascending velocity and the boiling depth of the thermal water in the well or the reservoir as functions of steam properties which can be observed at the wellhead. The knowledge gained by this method may be useful in estimating the hydrothermal system of the geothermal field. A few practical examples are given. (See also W74-08973) (Knapp-USGS) W74-09028

#### FACTORS CONTROLLING BOREHOLE PERFORMANCE.

Department of Scientific and Industrial Research, Taupo (New Zealand).

For primary bibliographic entry see Field 2F.

W74-09034

#### CURRENT STATUS OF GEOTHERMAL POWER PLANTS AT THE GEYSERS, SONOMA COUNTY, CALIFORNIA.

Pacific Gas and Electric Co., San Francisco, Calif. Dept. of Engineering.

D. B. Barton.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1552-1559, 1973, 4 fig.

Descriptors: \*Geothermal studies, \*Thermal power, \*California, Thermal powerplants, Hydrothermal studies, Steam. Identifiers: \*Geothermal power.

Electric power has been produced in commercial quantities from geothermal steam at The Geysers in Sonoma County, California, since 1960. Development at The Geysers started in 1922 when the first steam well was drilled. Eight wells were drilled from that date through 1925. However, commercial development was not feasible at that time. Some steam was used at an adjacent resort for heating and also, through use of two small reciprocating steam engine-generators, lighting was provided until 1959. Present development started with well drilling in 1955. As condensed water is contaminated, principally with ammonia, sulfides, and boron, its disposal presents a serious problem. Injection wells are currently being used for this purpose. The steam supply is slightly superheated and contains ammonia, carbon dioxide, and hydrogen sulfide as principal contaminants, amounting to 0.3% to 2.0% of the steam. (See also W74-08973) (Knapp-USGS) W74-09035

#### PHYSICO-CHEMICAL SAMPLING OF HIGH TEMPERATURE WELLS IN CONNECTION WITH THEIR ENCRUSTATION BY CALCIUM CARBONATE.

Adademiya Nauk SSSR, Novosibirsk, Institut Neorganicheskoi Khimii.

P. A. Kryukov, and E. G. Larionov.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1624-1628, 1973, 9 fig, 2 tab, 6 ref.

Descriptors: \*Hydrothermal studies, \*Thermal power, \*Water chemistry, \*Scaling, Water wells, Well casings, Well screens, Corrosion, Sampling, Instrumentation, Water temperature. Identifiers: \*Geothermal power, \*USSR.

The most important practical problems of physico-chemical studies of high-thermal underground waters are connected with the conditions of well encrustation due to calcium carbonate. Methods were developed for use in high-thermal waterfields

of Bolshebanny and Pauzhetsky in Kamchatka and Goryachy Plazh (Hot Beach) on Kunashir island, USSR. For water sampling of operating wells, a probe (a tube made of stainless steel) was used and inserted in the well through a gasket below the vaporization level. To measure pH in deep-seated water samples the probe was connected to a high-temperature cell with a glass and reference electrodes mounted in autoclave where natural pressure and temperature conditions were created. A thermistor was used for the continuous temperature measurement at different depths and for determining the position of vaporization zones in operating wells. (See also W74-08973) (Knapp-USGS)  
W74-09036

**GEOTHERMAL ENERGY RESOURCES FOR HEATING AND ASSOCIATED APPLICATIONS IN ROTORUA AND SURROUNDING AREAS,**  
Ministry of Works, Rotorua (New Zealand).  
W. Burrows.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1662-1669, 1973. 6 fig, 1 tab.

Descriptors: \*Geothermal studies, \*Hot springs, Thermal water, Heated water, Heating, Water utilization, Water resources development.  
Identifiers: \*New Zealand.

Geothermal heat is available in Rotorua, New Zealand, for domestic, commercial, and potential industrial purposes. A map is given to assist in demonstrating the various heat zones and areas of productivity. An assessment is made of all areas indicating the proved potential and the possible development. (See also W74-08973) (Knapp-USGS)  
W74-09042

**SOME METHODS OF DEALING WITH LOW ENTHALPY WATER IN THE ROTORUA AREA OF NEW ZEALAND,**

Cooke (W. L.) Ltd, Auckland (New Zealand).  
W. L. Cooke.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1670-1675, 1973. 6 fig, 7 ref.

Descriptors: \*Geothermal studies, \*Hot springs, Thermal water, Heated water, Heating, Water utilization, Water resources development.  
Identifiers: \*New Zealand.

A review is presented of some changes and developments which have taken place in methods of controlling and using low enthalpy water in New Zealand. Laws which govern the utilization of underground hot waters, the techniques of construction, maintenance, and function of the wells, and of the plants for utilization and discharge are reviewed. Hot waters are used in houses, greenhouses, air conditioning, baths, and swimming pools. (See also W74-08973) (Knapp-USGS)  
W74-09043

**THE ECONOMICS OF THE SMALL GEOTHERMAL POWER STATION,**  
Department of Scientific and Industrial Research, Wairakei (New Zealand). Chemistry Div.  
For primary bibliographic entry see Field 6C.  
W74-09045

**ECONOMICS OF THE GEYSERS GEOTHERMAL FIELD, CALIFORNIA,**  
Thermal Power Co., San Francisco, Calif.  
For primary bibliographic entry see Field 6C.  
W74-09046

**ECONOMICS OF GEOTHERMAL ELECTRIC POWER GENERATION AT MATSUKAWA,**  
Japan Metals and Chemicals Co. Ltd., Tokyo. Exploitation Dept.  
For primary bibliographic entry see Field 6C.  
W74-09047

**WAIKAKEI POWER STATION NEW ZEALAND—ECONOMIC FACTORS OF DEVELOPMENT AND OPERATION,**  
Ministry of Works, Wellington (New Zealand).  
For primary bibliographic entry see Field 6C.  
W74-09048

**NEUTRON WELL LOGGING IN HAWAII,**  
Hawaii Univ., Honolulu. Water Resources Research Center.  
F. L. Peterson.

Available from the National Technical Information Service as PB-233 124, \$3.25 in paper copy, \$1.45 in microfiche. Technical Report No 75, February 1974. 42 p, 15 fig, 4 tab, 9 ref. OWRR A-032-HI(2). 14-31-0001-3511.

Descriptors: \*Hawaii, \*Logging(Recording), Water wells, \*Porosity, Gamma rays, Radiation, Basalts, Correlation analysis, Equipment, Aquifers, Water yield.  
Identifiers: \*Neutron well logging.

The primary objective was to apply neutron logging techniques to the problem of obtaining reliable porosity data and relating these to water yields from Hawaiian aquifers. Neutron well logging in Hawaiian basaltic formations has produced much important qualitative and quantitative information. The most important application has been the determination of porosity in the saturated zones. Interpretation of neutron log responses in Hawaiian basaltic formations is similar to conventional neutron log interpretation in sedimentary formations. Neutron count varies as an inverse function of porosity. High neutron counts are indicative of low porosities and low neutron counts are indicative of high porosities. In general, the neutron logs are extremely responsive to detailed changes in formation porosity, and of particular importance is that the reproducibility of neutron logs from the same well is excellent. Neutron logs from Hawaiian wells also are extremely responsive to the saturated-unsaturated boundary and to the casing termination. Surprisingly, the neutron logs show little consistent response to nominal hole diameter or borehole fluid salinity. Probably the best use of the neutron logs is in conjunction with other borehole geophysical logs. Correlation between neutron logs and electric resistivity logs is particularly good.  
W74-09053

**DESIGN AND OPERATION OF LAND TREATMENT SYSTEMS FOR MINIMUM CONTAMINATION OF GROUND WATER,**  
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
For primary bibliographic entry see Field 5D.  
W74-09089

**ARTIFICIAL RECHARGE—STATE OF THE ART,**  
Geological Survey, Lubbock, Tex.  
R. F. Brown, and D. C. Signor.  
Ground Water, Vol 12, No 3, p 152-160, May-June 1974. 48 ref.

Descriptors: \*Artificial recharge, \*Waste water disposal, Water storage, Hydrogeology, \*Reviews, Research and development, Water quality control, Water management(Applied).

The largest potential underground reservoir for the storage of potable water is in the unsaturated zone. Artificial recharge has many similarities to liquid-

waste disposal through deep wells. In both, the problem is to place liquid in a permeable lithologic unit at an economic rate, to predict movement and the chemical reactions and physical changes that take place while the liquid is in the reservoir. In both artificial recharge and liquid-waste storage, the nature of the storage must be known, particularly that of the unsaturated zone. Water commonly is recharged by surface spreading through basins or by induced recharge from adjacent streams and lakes or through injection wells. Research in recharge through basins has been dominated by mathematical models based on idealized conditions and empirical relations, derived by experimental sequencing of recharge operations, and operational controls in the pretreatment of recharge water. Recharge by injection wells has been undertaken in a variety of hydrologic environments. In Israel, efforts have been directed toward the analyses of diffusion and dispersion of the injected water. Much research in the United States has been directed toward the movement of bacteria and organic matter through an aquifer and toward the chemical modeling of changes in recharged water as it moves. (Knapp-USGS)  
W74-09091

**BORE HOLE SAMPLING OF SATURATED UNCEMENTED SANDS AND GRAVELS,**  
Commonwealth Scientific and Industrial Research Organization, Syndal (Australia). Div. of Applied Geomechanics.

C. M. Barton.  
Ground Water, Vol 12, No 3, p 170-181, May-June 1974. 2 fig, 11 ref, append.

Descriptors: \*Sampling, \*Boreholes, Core drilling, Core logging, Sands, Gravels, Cores, Water wells, Equipment.  
Identifiers: \*Borehole sampling.

Borehole sampling of loose saturated sands and gravels forms a very important part of water well investigations. The materials are often difficult to sample and the adoption of adequate equipment and techniques can sorely tax the ingenuity of the driller. In some situations, the standard exploration sampling procedures can provide satisfactory information, while in others, it is necessary to resort to more precise techniques. A great variety of samplers have been designed including types such as open drive, piston drive, jet and extension flap samplers. No single sampler can cover the very wide range of material conditions and operational requirements which may be met during the drilling of water wells. In extreme circumstances, particularly for uncemented or poorly cemented gravels, it may be found necessary to stabilize the strata prior to sampling. (Knapp-USGS)  
W74-09094

**A QUIET REVOLUTION: FLORIDA'S FUTURE ON TRIAL,**  
Florida State Senate, Tallahassee.  
D. R. Graham.  
The Florida Naturalist, Vol 45, No 5, p 146-151, 1972. 1 photo.

Descriptors: \*Florida, \*Water supply, \*Land use, Watersheds(Basins), Legislation, Water resources development, Droughts, Non-structural alternatives, Zoning.

A counter-movement is underway among the states to recapture some of the land use powers which had previously been delegated to local government. Environmental crises have provided the catalyst for enactment of state land use legislation. In Florida, a crisis appeared in form of an immediate drought—and also uneasiness over current and projected population growth. During 1970 and 1971, the water supply for over two million residents reached dangerously marginal levels, and for the first time, the flood control districts pumped surface water into well fields. Thus, the

## Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

### Group 4B—Groundwater Management

dwindling supply of water in canals and conservation areas was committed to avoid massive salt water intrusion in the water supply of Dade County. A special conference noted that in order to provide an adequate long-range water supply, the state must have a comprehensive land and water use plan. The conference also articulated the concern over population pressures and concluded that there is a limit to the number of people which the south Florida basin can support. Numerous pieces of legislation were enacted following the conference to provide a plan assessing the quality and quantity of natural resources, especially water. (Ritchie-Florida)  
W74-09173

**WATER-LEVEL CHANGES IN NORTHWESTERN KANSAS, 1950-73.**  
Geological Survey, Garden City, Kans.  
M. E. Pabst, and E. D. Jenkins.  
Kansas Geological Survey Journal, October 1973. 14 p, 1 fig, 2 tab, 13 ref.

Descriptors: \*Water levels, \*Groundwater, \*Water wells, \*Kansas, Withdrawal, Drawdown, Water yield, Irrigation water, Hydrologic data.

The water level in wells has declined as much as 36 feet since 1950 in parts of northwestern Kansas, primarily as a result of groundwater withdrawals for irrigation. During 1950-72, the number of irrigation wells increased from about 100 to 2,250, and annual withdrawals are estimated to have increased from 15,000 to 500,000 acre-feet. (Knapp-USGS)  
W74-09194

**PARTIAL AREA HYDROLOGY AND ITS APPLICATION TO WATER RESOURCES.**  
Agricultural Research Service, University Park, Pa. Northeast Watershed Research Center.  
For primary bibliographic entry see Field 2A.  
W74-09200

**IMPROVEMENT OF TROUT STREAMS IN WISCONSIN BY AUGMENTING LOW FLOWS WITH GROUND WATER.**  
Geological Survey, Washington, D.C.  
For primary bibliographic entry see Field 3B.  
W74-09224

**ANNUAL REPORT ON GROUND WATER IN ARIZONA, SPRING 1972 TO SPRING 1973.**  
Geological Survey, Phoenix, Ariz.  
Arizona Water Commission Bulletin 7, April 1974. 46 p, 31 fig, 3 plates, 1 tab, 2 ref.

Descriptors: \*Groundwater, \*Arizona, \*Water utilization, \*Withdrawal, \*Water levels, Drawdown, Water yield, Water resources development, Data collections, Hydrologic data.

Water levels in selected wells and annual groundwater pumpage in most of the developed areas in Arizona were determined. Maps show hydrologic conditions in Sacramento and Hualapai Valleys, potential well production by areas, depth to water in selected wells in spring 1973, and change in water levels in selected wells from 1968 to 1973. Nearly two-thirds of Arizona's water supply comes from the groundwater reservoirs. Although municipal and industrial uses are increasing, the greatest use is for irrigation of crops. For the 20th consecutive year, the withdrawal of groundwater exceeded 4 million acre-feet. In 1972 the withdrawal of groundwater was nearly 5 million acre-feet. (Knapp-USGS)  
W74-09229

### 4C. Effects On Water Of Man'S Non-Water Activities

**FORECASTING CHANGES IN WATER BALANCE UNDER INFLUENCE OF HUMAN ACTIVITY (PROGNOZIROVANIYE IZMENENIY VODNOGO BALANSA POD VLIYANIYEM KHOZYAYSTVENNOY DEYATEL'NOSTI).**  
For primary bibliographic entry see Field 4A.  
W74-08709

**PREDICTING THE HYDROLOGIC EFFECTS OF LAND MODIFICATIONS.**  
Arizona Univ., Tucson.  
For primary bibliographic entry see Field 4A.  
W74-08753

**ENVIRONMENTAL PROTECTION AND ENERGY CONSERVATION GO HAND-IN-HAND.**  
For primary bibliographic entry see Field 5B.  
W74-08865

**FOREST FIRES DAMAGE MORE THAN TREES.**  
American Forestry Association, Washington, D.C.  
C. A. Connaughton.  
American Forests, Vol 78, p 30-31, 60-62, August 1972. 2 photo.

Descriptors: \*Burning, \*Forest management, \*Watershed management, \*Forest fires, Infiltration, Flood protection, Flood damage, Carrying capacity, Erosion control, Recreation, Wildlife conservation, Public lands, Surface runoff, Channelization, Flood plain zoning, Watershed protection.  
Identifiers: Controlled burning.

The protection of forest land from wildfires is necessary in order to provide protection from floods, which would invariably follow. It was watershed values in relation to fire, not forest production values, that triggered the designation of public lands as national forests. When a fire occurs on a steep mountain watershed subject to torrential storms, devastating mudrock flows can be expected with major loss of property and even life, since the runoff is greatly accelerated and can carry large volumes of debris. With plant cover and normal soil infiltration rates, water of the best quality will be yielded. With plant cover destroyed by fire, debris laden streams may result with adverse influence on water supplies, fish spawning, reservoirs, and other hydraulic water quality features. After a watershed area is burned over, the problem arises as to what can be done to protect and rehabilitate the watershed. If flood damage is likely, land managers can immediately plan to restore the ground cover. This is usually done by seeding a quick growing plant. Sometimes preventative steps are undertaken such as debris racks, enlarged culverts, channel clear-out, and relocation of critically situated improvements. (Sperling-Florida)  
W74-09126

**EFFECT OF URBANIZATION ON RUNOFF FROM SMALL WATERSHEDS.**  
Arizona Univ., Tucson. Water Resources Research Center.  
S. E. Kao, M. M. Fogel, and S. D. Resnick.  
In: Hydrology and Water Resources in Arizona and the Southwest, Proc. of the 1973 meetings of the Arizona Section-American Water Resources Assn. and the Hydrology Section-Arizona Academy of Science, May 4-5, 1973. Tucson, Arizona, p 86-91 (1973). 5 fig, 3 tab, 8 ref. OWRR B-012-ARIZ(4) and B-023-ARIZ(3).

Descriptors: \*Urbanization, \*Watersheds(Basins), Runoff, \*Urban runoff, \*Rainfall-runoff relationships, Infiltration, Rainfall, Rainfall intensity, Peak discharge, Regression analysis.

Hydrologic data obtained from three urban and one rural experimental watersheds were analyzed to determine urbanization effects on runoff. A Soil Conservation Service procedure was used to explain the relationship between rainfall amounts and runoff. A runoff curve number obtained indicated that convective storm rainfall can be related to the runoff volume from small, semiarid watersheds. A linear relationship existed between runoff volume and its corresponding peak discharge rate. Urban watersheds with a high percentage of impervious areas may not necessarily produce high peak rates for a given volume of runoff. Results show that the SCS method of relating runoff volume to rainfall is sufficiently sensitive to determine the effect of urbanization on the volume of runoff. (Mastic-Arizona)  
W74-09245

### 4D. Watershed Protection

**EFFECT OF LONG-TERM MANAGEMENT ON PHYSICAL AND CHEMICAL PROPERTIES OF THE COSHOCTON WATERSHED SOILS.**  
Agricultural Research Service Coshocton, Ohio. North Appalachian Experimental Watershed.  
W. M. Edwards, J. L. McGuinness, D. M. Van Doren, Jr., G. F. Hall, and G. E. Kelley.  
Soil Science Society of America Proceedings, Vol 37, No 6, p 927-930, November-December, 1973. 5 tab, 22 ref.

Descriptors: \*Water supply development, \*Soil conservation, Water conservation, Runoff, Fertility, Erosion control, Water pollution sources, \*Ohio, Watersheds(Basins), \*Crop response.  
Identifiers: \*Coshocton watershed(Ohio).

After 30 years of differential treatment, 0.7- to 3.2-ha watersheds in improved management had higher crop yields and less runoff and erosion than watersheds under prevailing management. Soil samples were taken from the topsoils, plowsoils, and B horizons of the watersheds to determine the effect of such management on soil physical and chemical characteristics. Large changes in chemical characteristics resulted from the higher fertilization associated with improved management but the changes generally did not persist below the topsoil layer. Measurable differences in physical characteristics of the watershed soils were slight and were confined to the topsoil layer. Differences in crop yield and hydrologic performance are attributed to fertilization, crop growth, and tillage differences associated with the two levels of management. (Skogerboe-Colorado State)  
W74-08813

**CONSERVATION AND LAND DEVELOPMENT.**  
For primary bibliographic entry see Field 6E.  
W74-09153

**COUNTY SEDIMENT CONTROL PROGRAMS.**  
For primary bibliographic entry see Field 6E.  
W74-09157

## 5. WATER QUALITY MANAGEMENT AND PROTECTION

**METHOD OF PURIFYING WATER.**  
S. R. Kennedy.  
U.S. Patent No. 3,801,501, 3 p, 2 ref; Official Gazette of the United States Patent Office, Vol 921, No 1, p 305, April 2, 1974.

Descriptors: \*Patents, \*Waste water treatment, \*Chemical reactions, \*Neutralization, \*Water purification, \*Water supply, pH, Iron, Ammonia, Flocculation, Chlorination, Potable water, Water reuse.

Identifiers: \*Chemical treatment, Sulfuric acid.

Polluted water is first mechanically treated to clarify it and remove most of the suspended or retained solids. The treated water is mixed with sulfuric acid to decrease the pH to 2.5 and the acidified water is maintained at this pH for at least 3 1/2 minutes. The effluent from this step is monitored so that the pH can be maintained at the desired point. Maintenance of the desired pH is accomplished by introducing a further amount of sulfuric acid during the period before the next step if the pH begins to rise above the selected pH. The acid-containing water is then brought in contact with a source of iron such as iron bars, iron plates, or scrap iron in sufficient quantity to have 3.2 square feet of surface of the iron exposed to the acid liquid for every gallon per minute flow. The reaction with the iron takes place during the retention time of 6 minutes in the iron treatment tank. The pH rises to about 3.5. After the iron treatment the water is neutralized utilizing ammonia. The water is thoroughly mixed with the ammonia so that the neutralizing is effective throughout and the water is brought to a pH of at least 7. In lieu of ammonia, sodium hydroxide, barium hydroxide or potassium hydroxide may be substituted. The iron salt in the water acts as a flocculating agent but other flocculating agents such as aluminum sulfate may be added. The water may also be subsequently treated with chlorine and also mechanically degassed to improve the quality of the effluent. (Sinha-OEIS)

W74-09186

## 5A. Identification Of Pollutants

USE OF DAPHNIA MAGNA FOR THE MICROBIO-ASSAY OF PESTICIDES. I. DEVELOPMENT OF STANDARDIZED TECHNIQUES FOR REARING DAPHNIA AND PREPARATION OF DOSAGE MORTALITY CURVES FOR PESTICIDES, D. E. H. Frear, and J. E. Boyd. Journal of Economic Entomology, Vol 60, p 1228-1239, 1967.

Descriptors: \*Bioassay, \*Daphnia, Testing procedure, Pesticides, Pollutant identification, \*Pesticide residues, Toxicity, Insecticides, Mortality, Water pollution effects.

It is possible to rear *Daphnia magna* under closely-controlled laboratory conditions, when asexual reproduction yields a homogeneous population suitable for microbio-assay of pesticide residues. Tests with various insecticides showed that some were toxic even in very low trace concentrations. Detailed procedure is given for rearing daphnids and using them for bio-assays, and dose-mortality curves and LD50 values are given for 56 common pesticides. (See also W74-08715)

W74-08714

USE OF DAPHNIA MAGNA FOR THE MICROBIO-ASSAY OF PESTICIDES. II. COMPARISON OF MICROBIO-ASSAY WITH GAS CHROMATOGRAPHY FOR ANALYSIS OF PESTICIDE RESIDUES IN PLANT EXTRACTS, D. E. H. Frear, and N. S. Kavar. Journal of Economic Entomology, Vol 60, p 1228-1239, 1967.

Descriptors: \*Bioassay, *Daphnia*, Testing, Pesticide residues, Gas chromatography, Toxicity, Pollutant identification, Toxicity, Insecticides, Mortality, DDT, Water pollution effects.

Identifiers: Ethion, Lindane.

The *Daphnia* bio-assay method was compared with gas chromatography for determining traces of pesticides (DDT, ethion, and lindane), and gas chromatography gave more accurate and more consistent results. (See also W74-08714)

W74-08715

AN INVESTIGATION OF THE COULTER COUNTER IN 'BIOMASS' DETERMINATIONS OF NATURAL FRESHWATER PHYTOPLANKTON POPULATIONS, Royal Holloway Coll., Englefield Green (England).

J. H. Evans, and S. M. McGill.

Hydrobiologia, Vol 35, No 3/4, p 401-419, 1970 (illus).

Descriptors: \*Algae, \*Growth rates, \*Phytoplankton, \*Biomass, Water pollution effects, Pollutant identification.

Identifiers: Coulter counter.

During the period Nov. 1965 to Nov. 1968 an investigation was made into the use of the Model A Industrial Coulter Counter for determining the biomass of freshwater phytoplankton. Parallel determinations of other parameters, including algal numbers, calculated algal volumes, dry weight, C content and chlorophyll pointed towards the general validity of the results obtained by the electronic method provided the background level of non-algal detritus is relatively low. The importance of parallel determinations, especially those involving visual inspection of samples, is emphasized. For uni-algal samples, either from culture or nature, or for natural samples dominated by 1 sp., the Coulter Counter does not necessarily give a quicker result than traditional methods of analysis. However, for at least 2 reasons the Coulter Counter adds a most useful new dimension to the realm of phytoplankton analysis. For assemblages of algae, whether or not certain species are dominant or co-dominant, a more rapid determination of a result, which can be taken to represent the biomass, is possible than by other methods. Such results, expressed here as total particulate volume (T.P.V.), can be accepted as being as accurate as those obtained by any other method and are probably better than some. In addition to the single figure T.P.V. result for a sample, volume analyses within selected size and particle number ranges can be made.

W74-08727

HEAVY METAL CONCENTRATIONS IN MUSEUM FISH SPECIMENS: EFFECTS OF PRESERVATIVES AND TIME, Smithsonian Institution, Washington, D.C. Dept. of Vertebrate Zoology.

R. H. Gibbs, Jr., E. Jarosewich, and H. L.

Windom.

Science, Vol 184, No 4135, p 475-477, April 26, 1974, 2 fig, 5 ref.

Descriptors: \*Cadmium, \*Copper, \*Zinc, Mercury, \*Lead, Fish physiology, Time, \*Heavy metals, \*Pollutant identification.

Identifiers: Metals concentration, \*Preservatives effects.

Higher concentrations of cadmium, copper, zinc, and sometimes lead, and lower concentrations of mercury and sometimes lead were found in specimens of myctophid fish preserved for one month in formalin, ethyl alcohol, and isopropyl alcohol as compared with unpreserved frozen specimens. Properties of the preservatives and species differences in fish tissues both influence these metal concentrations. Until the changes resulting from preservation are understood, comparisons of concentrations of metals between museum specimens and unpreserved or frozen specimens must be considered unreliable. (Sandoski-FIRL)

W74-08792

DESIGN OF COST-EFFECTIVE WATER QUALITY SURVEILLANCE SYSTEMS,

Raytheon Co., Portsmouth, R.I. Oceanographic and Environmental Services.

V. Beckers, and G. Chamberlain.

Copy Available from GPO Sup Coc as EPI.23:600/5-74-004, \$4.05; microfiche from NTIS as PB-232 979 \$1.45. Environmental Protection Agency, Socioeconomic Studies Series Report EPA-600/5-74-004, January 1974, 413 p, 91 fig, 34 tab, 31 ref. EPA Program Element IBA030, 68-01-0703.

Descriptors: \*Network Design, \*Monitoring, \*Mathematical Models, \*Systems Analysis, \*Data Collection, Reliability, Maintenance, Costs, Water Quality, Pollution Abatement, \*Ohio, \*Pennsylvania, Water Pollution, Measurement, Water Quality Control, Water Quality Act.

Identifiers: \*Beaver River Basin(Ohio-Penn), \*Cost Effectiveness, Surveillance, Ohio River Basin.

This report presents the development and successful demonstration of quantitative methods for the design of river basin water quality surveillance systems for pollution abatement. The methods provide a systematic approach to the consideration of expected stream conditions, system characteristics, equipment performance, and cost in the selection of a preferred system design from among a number of candidates. In the systems approach, the total system is evaluated for cost and effectiveness. Mathematics previously developed to describe the effectiveness of sampling is used. The analysis of performance draws heavily on reliability and maintainability technology. Data availability remains a constraint to the general application of the methods. The methods are computerized and the computer programs are detailed. They make use of the information available from the computerized river basin models now under general development. They are demonstrated to function satisfactorily on the Beaver River Basin when artificial data are used to supplement the data base. It is concluded that the methods are acceptable for use by governmental water quality agencies under the existing constraints. (EPA)

W74-08825

INVESTIGATION OF SURFACE FILMS - CHESAPEAKE BAY ENTRANCE,

Virginia Inst. of Marine Science, Gloucester Point. W. G. MacIntyre, C. L. Smith, J. C. Mundy, V. M. Gibson, and J. L. Lake.

Copy Available from GPO Sup Doc as EPI.23:670/2-73-099, \$2.05; microfiche from NTIS as PB-232 968, \$1.45. Environmental Protection Agency Technology Series Report EPA 670/2-73-099, February 1974, 168 p, 32 fig, 22 tab, 105 ref. EPA Project 15080 EJ0.

Descriptors: \*Oil spills, \*Estuarine environment, \*Chesapeake Bay, Oil Pollution, Estuaries, Currents, Sampling, Chemical Analysis, Chromatography, Chlorinated Hydrocarbons, Pesticides, Liquids, \*Path of pollutants.

Identifiers: \*Surface films, \*Oil slicks, Remote sensing, Hydrocarbon analysis, Oil aging, Fatty acids.

Experimental point source oil releases have been conducted in the Chesapeake Bay mouth area. Predictions of oil slick motion were tested, and slicks were sampled and analyzed to measure their aging rates over periods up to 32 hours. Remote sensing techniques were used to detect and measure the spreading rate of oil. Some laboratory oil film experiments were done to further document and elucidate aging processes. Results indicate a reasonable motion prediction, an explanation of the non-biological initial aging of oil films, and a fair corroboration of a theoretical oil spreading model. Indigenous surface films in the study area were analyzed for lipid and chlorinated hydrocarbon content. Hydrocarbons were 300-500 microgram per liter and fatty acids and ester 700-800

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

microgram per liter in surface film samples. Chlorinated hydrocarbons were generally less than 100 parts per trillion in surface films, in contrast to some earlier high concentrations found in Biscayne Bay. Surface film analysis limitations imposed by sampling methods are discussed. Plankton in slick, non-slick, and subsurface water were counted. Populations were higher in surface than subsurface water, and higher in non-slick than in slicked surface water. (EPA) W74-08831

**STREAM STANDARDS: DEAD OR HIDING,** Johns Hopkins Univ., Baltimore, Md. Dept. of Geography and Environmental Engineering. For primary bibliographic entry see Field 5G. W74-08866

**DETERMINING THE BIODEGRADABILITY OF ORGANIC COMPOUNDS.** For primary bibliographic entry see Field 5B. W74-08867

**ENVIRONMENTAL RADIATION DOSE CRITERIA AND ASSESSMENT-PATHWAY MODELING AND SURVEILLANCE,** Brookhaven National Lab., Upton, N.Y. Health Physics and Safety Div. For primary bibliographic entry see Field 5B. W74-08875

**INSTRUMENTATION AND ENVIRONMENTAL RADIATION ASSESSMENT SYSTEMS,** Office of Radiation Programs, Washington, D.C. For primary bibliographic entry see Field 5B. W74-08876

**RADIOLOGICAL ENVIRONMENTAL MONITORING--THE EPA APPROACH,** Office of Radiation Programs, Washington, D.C. W. D. Rowe. IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 416-422, February, 1974. 6 fig, 3 tab, 9 ref.

Descriptors: \*Monitoring, \*Radiation, Model studies, Instrumentation, Local governments, Costs. Identifiers: Environmental radiation doses.

The approach of the Environmental Protection Agency to monitoring is discussed, with emphasis on dose computation utilizing source data, environmental models, and minimal monitoring for validation. This approach, which requires extensive use of models to predict dose and minimal environmental measurements, is expected to be more cost effective than the conventional approach. The need for monitoring at the state and/or local level is primarily to enforce standards and to obtain timely and effective data upon which emergency response decisions can be based. The EPA approach to radiological environmental monitoring will require the development and use of instrumentation which provides the data to implement this approach in the most cost effective manner. (Merritt-FIRL) W74-08877

**THE NEED FOR AN INDICATOR VIRUS IN WATER QUALITY TESTING,** Water Pollution Control Federation, Washington, D.C. Technical Services. E. DeMichele, G. W. Burke, Jr., and M. S. Shane. Water and Sewage Works, Vol 121, No 4, p 39, April, 1974.

Descriptors: \*Water quality, \*Viruses, \*Bioindicators, Water analysis, Water pollution, Testing, Public health.

Water quality problems are discussed and the need for an indicator virus in water quality testing is

proposed. The validity of the coliform test as an indicator of potential pathogenic microbial water pollution is being increasingly questioned. The fact that laboratory studies have shown enteroviruses to be more resistant to normal water and waste water chlorination practices than organisms of the coliform group lends justification to the hypothesis that coliform counts may not adequately monitor viral infection of water. The main problem is knowing the viruses exist, but being unable to measure them accurately or knowing which, if any, might cause infection. A test procedure for an indicator virus is proposed to be developed in a manner paralleling the use of *E. coli* as an indicator bacterium. The procedure should provide a rational means of measuring treatment efficiency in terms of human health and well being. It is not necessary that the virus be pathogenic, but rather, it should be similar to infectious viruses in terms of make up, tolerance, and stability. (Merritt-FIRL) W74-08880

**DETECTION SYSTEMS FOR THE LOW LEVEL RADIOCHEMICAL ANALYSIS OF IODINE-131, IODINE-129 AND NATURAL IODINE IN ENVIRONMENTAL SAMPLES,** Battelle-Pacific Northwest Labs., Richland, Wash. F. P. Brauer, and J. H. Kaye. IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 496-502, February, 1974. 10 fig, 1 tab, 25 ref.

Descriptors: \*Iodine radioisotopes, \*Neutron activation analysis, \*Separation techniques, \*Oxidation, Gamma rays, Spectrometers, Measurement, \*Pollutant identification.

A procedure based on chemical separation techniques and activation analysis has been developed for the sequential analysis of low levels of I131, I129, and natural iodine in environmental samples. The iodine is first separated from the samples by oxidation. The separated iodine is then counted by low level, beta-gated gamma-ray spectrometry for the measurement of I131. The chemical yield for the separation is measured by means of I125 tracer. Activation analysis is used for measurement of the separated natural iodine, I127 and I129. The natural iodine is estimated from either the I126 or I128 activity produced in the sample. The induced I130 is used to estimate the I129 concentration. Measurements have been made of iodine radioactivity in the environment at concentrations below the limits established for radiation protection purposes. (Merritt-FIRL) W74-08885

**GE(LI) LOW LEVEL IN SITU GAMMA-RAY SPECTROMETER APPLICATIONS,** California Univ., Livermore. Lawrence Livermore Lab. P. L. Phelps, L. R. Anspaugh, S. J. Roth, G. W. Huckabay, and D. L. Sawyer. IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 543-552, February 1974. 8 fig, 4 fig, 10 ref.

Descriptors: \*Spectrometers, \*Radioisotopes, \*Soils, Measurements, Methodology, Liquid wastes, Gases, Effluents, Analytical techniques, \*Pollutant identification, \*Nevada. Identifiers: \*Ge(Li) spectrometer.

The application of a Ge(Li) spectrometer for in-situ measurements of radionuclides contained in soil is described. This is being done at nuclear reactor sites and in complex radionuclide fields at the Nevada Test Site. The methodology and precision of the in-situ spectrometer technique has previously been established for analysis of radionuclides in soil. Application of the technique to gaseous and liquid effluents containing radionuclides has shown a great deal of promise. (Merritt-FIRL) W74-08886

**COMPARISON OF GE(LI) AND ANTICOMPTON SYSTEMS FOR MEASUREMENTS OF ENVIRONMENTAL SAMPLES,** Battelle-Pacific Northwest Labs., Richland, Wash. N. A. Wogman. IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 526-535, February, 1974. 17 fig, 2 tab, 21 ref.

Descriptors: \*Spectrometers, \*Gamma rays, \*Radioisotopes, Measurements, Equipment, Evaluations, \*Pollutant identification. Identifiers: \*Ge(Li) spectrometers, NaI(Tl) spectrometers.

A variety of sensitive low level counting systems are discussed from an analyst's viewpoint, centering on a variety of NaI(Tl) and Ge(Li) gamma ray spectrometers. The coincident gamma ray emitters are most sensitively detected through NaI(Tl) multi-dimensional gamma ray spectrometry, while single gamma ray emitters are very sensitively detected with Ge(Li) detector systems. NaI(Tl) detector systems are superior in general for environmental measurements. (Merritt-FIRL) W74-08887

**A GAMMA-RAY SPECTRUM ANALYSIS TECHNIQUE FOR LOW-LEVEL ENVIRONMENTAL RADIONUCLIDES,** Emory Univ., Atlanta, Ga. Dept. of Physics. R. E. Wood, and J. M. Palms. IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 536-542, February, 1974. 5 fig, 1 tab, 48 ref.

Descriptors: \*Spectrometers, \*Gamma rays, \*Analytical techniques, Measurements, \*Radioisotopes, Reviews, Equipment, \*Pollutant identification. Identifiers: \*Ge(Li) spectrometer.

The requirements for gamma-ray spectra analysis for low level environmental radionuclides are reviewed. Special emphasis is placed on the routine and rapid analysis of large numbers of samples. Pertinent requirements for analysis include the system energy and efficiency calibration, the library of gamma rays of concern, criteria of establishing the limits of sensitivity, and techniques used for gamma ray intensity and background determinations. An analysis code (CETUS) used with a Ge(Li) detector and multichannel analyzer interfaced to a programmable desk top calculator is described. (Merritt-FIRL) W74-08888

**METHOD AND APPARATUS FOR DETERMINING POLLUTION INDEX,** Environmental Devices Corp., Marion, Mass. (assignee) E. C. Brainard, II. U.S. Patent 3,807,860. Official Gazette of the U.S. Patent Office, Vol 921, No 5, p 1986, April 30, 1974. 1 fig.

Descriptors: \*Patents, Water pollution, Methodology, Equipment, Saline water, \*Salinity, \*Refractivity, \*Pollutant identification, \*Electrical conductivity. Identifiers: \*Pollution index.

A method and apparatus for providing an index of the concentration of pollutant in water is described. The index is determined according to the difference between two different measures of the salinity of water. In a preferred embodiment the two measures of salinity are measures of electrical conductivity and of refractive index. (Merritt-FIRL) W74-08893

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Identification Of Pollutants—Group 5A

#### SEDIMENTARY FLUORITE IN TAMPA BAY, FLORIDA

University of South Florida, Tampa, Fla. Dept. of Geology.  
W. H. Taft, and D. F. Martin.  
Environmental Letters, Vol 6, No 3, p 167-174, 1974. 4 ref.

Descriptors: \*Water sampling, \*Sampling, \*Sediments, Analytical techniques, Estuaries, \*Fluoride, Sea water, Temperature, Hydrogen ion concentration, \*Florida.  
Identifiers: \*Tampa Bay(FLA), \*Fluorite.

Water and sediment samples were collected at eight sites in Tampa Bay adjacent to the southernmost discharge canal of an industrial company, Gardiner, Incorporated. Water samples were frozen within 4 hours of collection and sediment samples were dried and prepared for x-ray diffraction. The results show: the existence of sedimentary fluorite; remarkably low pH meter readings which indicate the buffering capacity of 12 acre meters of estuarine water was virtually exhausted; the fluoride concentration is as much as 40 times its concentration in normal sea water, undoubtedly because of the complexing by hydrogen ions and silicon; and the temperature differentials in such relative shallow water are not only significant, but are the inverse of what would normally be expected. (Merritt-FIRL)  
W74-08907

#### AN AIRBORNE GAMMA RAY SPECTROMETER AND ITS APPLICATION IN NUCLEAR POWER PLANT SITE SURVEYS, Rice Univ., Houston, Tex.

G. E. Fryer, and J. A. S. Adams.  
IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 572-584, February, 1974. 8 fig, 4 tab, 15 ref.

Descriptors: \*Nuclear powerplants, \*Gamma rays, \*Spectrometers, \*Remote sensing, Monitoring, Air pollution, Radioactivity, Measurements, \*Texas, Instrumentation, Surveys, Flooding.  
Identifiers: Thermoluminescence dosimeters, Helicopters.

Airborne radiometric surveys from low flying helicopters have been completed for three nuclear power plant sites in Texas. The gamma ray counting data acquired in the air are converted to ground dose rate and plotted as a series of profiles. A radial flight line pattern provides easy position control and concentrates sampling density over the plant site. The 5-8 fold range of natural and man made radiation background within 10 miles of the three plant sites is statistically well characterized by over 14,000 spectra taken directly from 3.8% of each 314 sq mi survey area. The aerial dose estimates agree closely with thermoluminescence dosimeter data taken on the ground over 3 mo periods. The instrumentation system, survey rationales, data reduction, and analysis procedures are described. One of the major complications of the area is the periodic and extensive flooding of the rice fields, attenuating the gamma ray flux from the ground. (Merritt-FIRL)  
W74-08908

#### ENVIRONMENTAL DOSE MEASUREMENTS IN THE VICINITY OF NUCLEAR FACILITIES, duPont de Nemours (E.I.) and Co., Aiken, S.C. Savannah River Plant.

R. M. Hall, Jr., and D. I. Ross.  
IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 451-455, February, 1974. 6 fig, 1 tab, 6 ref.

Descriptors: \*Monitoring, \*Nuclear powerplants, \*Radiation, Measurements, Radioactivity, Instrumentation, Filters, \*South Carolina.  
Identifiers: \*Savannah River Plant(So.Car.), \*Dosimeters, Dosimetry systems.

The environmental radiation monitoring program for the Savannah River plant was recently altered to make more detailed readings at more locations in the plant's environs. Monitoring stations were increased from 40 to about 500. Additional stations were selected to improve the delineation and measurement of natural radiation. Monitoring stations near each operating area were supplemented by additional stations near effluent streams and at one mile intervals along the plant perimeter. Thirty fire towers within a 50 mile radius of the plant are used to place monitors up to 80 ft above the ground to aid in distinguishing between airborne and terrestrial radioactivity. Most measurements are taken quarterly, but several locations are measured biweekly to detect short term variations. (Merritt-FIRL)  
W74-08911

#### FLUID SAMPLE ANALYSIS SYSTEM, Durrum Development Corp., Palo Alto, Calif. (assignee)

For primary bibliographic entry see Field 7B.  
W74-08914

#### INVESTIGATION OF THE CHEMICAL IDENTITY OF SOLUBLE ORGANOPHOSPHORUS COMPOUNDS FOUND IN NATURAL WATERS, Illinois Inst. of Tech., Chicago. Dept. of Environmental Engineering.

R. A. Minear, and K. A. Walanski.  
Available from the National Technical Information Service as PB-232 972; \$3.75 in paper copy, \$1.45 in microfiche. Illinois Water Resources Center, Urbana, Research Report No 86, May 1974. 71 p, 25 fig, 12 tab, 53 ref, OWRR A-060-ILL(1). 14-31-0001-3813.

Descriptors: \*Pollutant identification, Cultures, Algae, \*Phosphorus compounds, \*Organophosphorus compounds, Chemical analysis, Water analysis, Aqueous solution.

Identifiers: Organic phosphorus, Algal soluble organics, \*Inositol phosphates, Sephadex, Gel filtration.

The ability of various laboratory algal cultures to generate substantial quantities of dissolved organic phosphorus (DOP) compounds has been demonstrated. After isolation and concentration of these compounds by low pressure filtration, freeze drying and redissolution, molecular size profiles on Sephadex gels were obtained. Comparison between DOP and inositol phosphate profiles on Sephadex G-25 prompted specific studies for the presence of inositol phosphates in the culture solutions. Alkaline bromination techniques established in soil chemistry research were employed in conjunction with Sephadex gel filtration to generate circumstantial evidence for the presence of inositol monophosphate and the absence of inositol hexaphosphate. The results obtained in conjunction with preliminary volatile derivative studies have provided the base for continued studies on the specific chemical nature of DOP compounds in aqueous systems.  
W74-08935

#### RELATIONSHIP BETWEEN BOD REMOVAL AND LAS DETERGENT REMOVAL IN WASTE-WATER TREATMENT SYSTEMS, Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5D.  
W74-08939

#### SPECIFIC ION MASS SPECTROMETRIC DETECTION FOR GAS CHROMATOGRAPHIC PESTICIDE ANALYSIS, Battelle Columbus Labs., Ohio.

M. B. Neher, and J. R. Hoyland.  
Copy Available from GPO Sup Doc as EPI.23:660/2-74-004, \$1.55; microfiche from NTIS as PB-233 136. Environmental Protection Agency,

Technology Series Report EPA-660/2-74-004, January 1974. 33 p, 15 fig, 7 ref, 2 append. EPA Project I6ADN28. Grant R-800909.

Descriptors: \*Mass spectrometry, \*Gas chromatography, \*Pollutant identification, Organic compounds, \*Computer programs, Data processing, \*Organic pesticides, Monitoring, \*Pesticides.  
Identifiers: \*Specific ion monitoring, Computer control, Pesticide mixture.

Computer programs have been developed for a PDP8/e controlling a Finnigan 1015 quadrupole mass spectrometer to monitor selected ions from components in a gas chromatographic effluent. The program is designed to monitor only a few ions (1 to 8) to enhance the sensitivity for the selected ions. Signal-to-noise levels of 10:1-30:1 have been obtained for 0.2 ng or less of four pesticides employing chemical ionization mass spectrometry and a digital smoothing routine. (EPA)  
W74-08943

#### HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM -- QUARTERLY SUMMARY REPORT -- DECEMBER 1, 1973 THROUGH MARCH 1, 1974, Health and Safety Lab. (AEC), New York.

For primary bibliographic entry see Field 5B.  
W74-08954

#### RADIOACTIVITY DISTRIBUTION IN THE STRATOSPHERE FROM CHINESE AND FRENCH HIGH YIELD NUCLEAR TESTS (1967-1970), National Oceanic and Atmospheric Administration, Silver Springs, Md. Air Resources Lab.

For primary bibliographic entry see Field 5B.  
W74-08955

#### HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM -- QUARTERLY SUMMARY REPORT -- DECEMBER 1, 1973 THROUGH MARCH 1, 1974, (APPENDIX), Health and Safety Lab. (AEC), New York.

E. P. Hardy, Jr.  
Available: NTIS, Springfield, Va., as Report No. HASL-281 (Appendix); \$10.60 per copy, \$1.45 microfiche. Report No. HASL-281, Appendix, April 1974, 459 p, 6 ref.

Descriptors: \*Data collections, \*Fallout, \*Strontium, \*Cesium, \*Sampling, \*Sites, \*Radioisotopes, Lead, Air pollution, Water pollution, Water pollution sources, Nuclear explosions, Milk, Potable water, Food chain, Public health.  
Identifiers: Deposition(Radioactive particles), Concentration.

Reports fallout deposition data of strontium and cesium from sampling sites around the world, radionuclides and lead in surface air, and radionuclides in milk and tap water. Tables of conversion factors and radionuclides of interest in the HASL fallout program are given. (See also W74-08954) (Houser-ORNL)  
W74-08956

#### NUCLEAR REACTIVITY EVALUATIONS OF 216-Z-9 ENCLOSED TRENCH, Atlantic Richfield Hanford Co., Richland, Wash. Research Dept.

Available from NTIS, Springfield, Va., as Report No. ARH-2915. Report No. ARH-2915, December 1973. 263 p, A. E. Smith, Compiler, 60 fig, 28 tab, 17 ref.

Descriptors: \*Plutonium, Survey, Measurement, Assay, \*Radioactivity, \*Trenches, \*Washington, Water pollution, Groundwater, Water table, Sites, Radioactive waste disposal, \*Remote sensing, Geology, Soils, Sampling, Model studies, Mathematical models, Chemical analysis.  
Identifiers: \*Richland(Wash).

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5A—Identification Of Pollutants

Plutonium accumulation and the nuclear criticality implications were evaluated for a subsurface liquid waste disposal site at Hanford, Washington. Remote plutonium detection by infrared, gamma, and neutron surveys are described. Geological drilling and soil sampling techniques were developed and described. Nuclear criticality safety was evaluated by computer model calculations and by neutron pulsing techniques. Technologies used to evaluate a waste disposal site for a plutonium recovery operation are discussed. (Houser-ORNL)  
W74-08966

**VASCULAR PLANTS OF WASTE STORAGE SITES IN THE 200 AREAS OF THE HANFORD RESERVATION.**  
Battelle-Pacific Northwest Lab., Richland, Wash. For primary bibliographic entry see Field 21.  
W74-08967

#### SEPARATION AND ANALYSIS OF NATURAL WATER.

Davidson Coll., Biology Div.  
Available from NTIS, Springfield, Va, as Rept No K-L-6119; \$4.00/copy, \$1.45/microfiche. Report No K-L-6119, September 1966. 23 p, 5 fig, 5 ref. (Also presented at the Symposium on the Capacity of Streams to Assimilate Wastes, 152nd Annual Meeting of the American Chemical Society, New York, September 1966.

Descriptors: \*Natural streams, Freshwater, Water pollution, Water pollution treatment, Water quality control, \*Radioactive wastes, Nuclear wastes, Centrifugation, Coagulation, Water purification, Limnology, Biology, Sediment load, \*Pollutant identification, \*Separation techniques.

Qualitative and quantitative fractionation of the various organic and inorganic species of particles occurring in natural water is a prerequisite to investigations of cycling of biologically or surface active contaminants in the aquatic biosphere. With the increasing release of these contaminants coinciding with increasing reuse of water, interest is developing in means of assessing the possible biohazard the contaminants may present. The suspended and colloidal sized organic particles typically found in natural water are emphasized, although the same theories and general methods apply to similar particles in other fluids and to inorganic particles. Generally, centrifugal methods are not practical for particles with a molecular weight of less than 10 to the sixth power and a sedimentation rate of less than 10S when dealing with large volumes of fluid. (Houser-ORNL)  
W74-08969

#### RADIOLOGICAL SURVEILLANCE AROUND TURKEY POINT, 1970-1971.

Florida State Div. of Health, Jacksonville. Radiological and Occupational Health Section. W. Johnson, and J. Eakins.  
Radiation Data and Report, Vol 15, No 3, p 105-115, March 1974. 2 fig, 23 tab, 3 ref.

Descriptors: \*Monitoring, \*Nuclear powerplants, \*Background radiation, Radioactivity, Environment, Air, Water, Local precipitation, Soil analysis, Soil contamination, Water pollution, Ocean water, Fresh water, Vegetation, Aquatic animals, Aquatic plants, Ecology, Algae, Crustaceans, Grasses, Fish, Food chains, \*Florida.  
Identifiers: \*Surveillance program, Preoperational, \*Turkey Point(Fla).

Prior to the operation of the Turkey Point Nuclear Power reactor, environmental media were sampled and data are presented for 1970-1971. Basic media investigated include air, precipitation, soil, silt, and water, including sea water. A number of media utilized as indicator organisms serve to investigate the behavior of radionuclides in several ecological levels. Indicators are mangrove vegeta-

tion, fresh water algae, turtle grass and sponges. Additional items found in the human food chain that were analyzed include crustacea, fish, and food crops. Data on the analysis of the various samples are given. (Houser-ORNL)  
W74-08970

#### PREOPERATIONAL LEVELS OF ENVIRONMENTAL RADIOACTIVITY IN WATER AND SEDIMENT AROUND TURKEY POINT NUCLEAR POWER PLANTS, CARD SOUNDS, FLORIDA.

Florida Univ., Miami. School of Medicine. T. S. Johnson, and T. D. Pemble.  
Radiation Data and Reports, Vol 15, No 3, p 117-123, March 1974. 2 fig, 3 tab, 6 ref.

Descriptors: \*Monitoring, Analytical techniques, \*Sampling, Instrumentation, Calibrations, Standards, Measurement, \*Radioisotopes, Radioactivity, Nuclear powerplants, Water pollution, Soil contamination, Silts, Sediments, \*Data collections, Sounds, \*Florida, \*Baseline studies.  
Identifiers: \*Card Sound(Fla), Preoperational studies.

An investigation of the levels and distribution of gross alpha, gross beta and selected gamma-emitting radioisotopes present in water and sediment samples from Card Sound, Florida, was performed. This environmental radioactivity baseline study was carried out between January 1971 and June 1972, prior to operation of the Turkey Point Nuclear Power Plants and discharge of liquid effluents from these plants into Card Sound. Sample collection and analysis for the various radionuclides found are described. (Houser-ORNL)  
W74-08971

#### RADIATION DATA -- SECTION II, WATER.

Environmental Protection Agency, Washington, D.C.  
Radiation Data and Reports, Vol 15, No 3, p 129, March 1974. 1 fig, 2 tab, 4 ref.

Descriptors: \*Monitoring, \*Sampling, \*Analytical techniques, \*Assay, \*Radioactivity, \*Water pollution, Ground water, Water pollution treatment, Water quality, Surface water, Water quality standards, Domestic water, Potable water.  
Identifiers: \*Surveillance program, Gross beta, Gross alpha.

Information is provided by Federal, State, and foreign governmental agencies and other cooperating organizations. Data reported are accumulated from surveillance programs concerning radionuclide concentrations of surface, ground, and treated water. Most of the analytical determinations are for gross beta and gross alpha radioactivity. These values are compared with the Public Health Service Drinking Water Standards. (Houser-ORNL)  
W74-08972

#### ENVIRONMENTAL RADIOACTIVITY IN THE FAROES IN 1972.

Danish Atomic Energy Commission, Risoe. Research Establishment.  
For primary bibliographic entry see Field 5B.  
W74-09086

#### ENVIRONMENTAL RADIOACTIVITY IN DENMARK IN 1972.

Danish Atomic Energy Commission, Risoe. Research Establishment.  
For primary bibliographic entry see Field 5B.  
W74-09087

#### ENVIRONMENTAL RADIOACTIVITY IN GREENLAND IN 1972.

Danish Atomic Energy Commission, Risoe. Research Establishment.

For primary bibliographic entry see Field 5B.  
W74-09088

#### WATER RESOURCES DATA FOR GEORGIA, 1973.

Geological Survey, Doraville, Ga.  
For primary bibliographic entry see Field 7C.  
W74-09116

#### MONITORING FOR TRACE METALS--WATER ENVIRONMENT.

National Environmental Research Center, Cincinnati, Ohio.  
D. G. Ballinger.  
In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 145-148, February 1973. 1 tab, 10 ref.

Descriptors: \*Monitoring, \*Trace elements, \*Water pollution control, Water pollution sources, \*Path of pollutants, Water analysis.

Monitoring for trace metals in the aquatic environment involves source and near-source sampling, as well as ambient monitoring for baseline data and trend analysis. A number of satisfactory analytical methods are available and in use to determine metals in water and waste samples. Good laboratory quality is essential to the monitoring program, and various manuals and reference samples are available from EPA to assist in establishing and maintaining efficient laboratory operations. (See also W74-09206) (Knapp-USGS)  
W74-09215

#### MONITORING OF SOLID WASTES,

Michigan Univ., Ann Arbor.  
E. A. Glysson.  
In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 149-152, February 1973. 6 ref.

Descriptors: \*Monitoring, \*Trace elements, \*Solid wastes, Landfills, Waste dumps, Water pollution sources.

Monitoring of solid wastes in general is far from adequate and for trace metals is hardly considered. More must be learned of the importance of trace metals from solid wastes upon the quality of the environment. Studies to date have not indicated that trace metals are a problem from this source, but more work needs to be done. (See also W74-09206) (Knapp-USGS)  
W74-09216

#### THE USE OF ION SPECIFIC ELECTRODES FOR CHEMICAL MONITORING OF MARINE SYSTEMS: PART I--THE AMMONIA ELECTRODE AS A SENSITIVE WATER QUALITY INDICATOR PROBE FOR RECIRCULATING MARICULTURE SYSTEMS.

Delaware Univ., Newark. Coll. of Marine Studies. R. F. Srna, C. Epifanio, M. Hartman, G. Pruder, and A. Stubbs.  
Available from NTIS, Springfield, Va 22151 as COM-73-11644, price \$2.75 printed copy; \$1.45 microfiche. Report DEL-SG-14-73, June 1973. 20 p, 4 fig, 4 tab, 4 ref. NOAA Grant 2-35223.

Descriptors: \*Monitoring, \*Ammonia, \*Aquaculture, \*Electrodes, Water chemistry, Water analysis, Sea water, Nutrients, Respiration, Water quality.

The ammonia ion specific electrode was tested as a water quality probe in recirculating mariculture systems. Its precision and ease of use make it

possible for the ammonia level in the system to be monitored routinely and the ammonia concentration used as a master variable, to detect rapid system changes involving both physical and biological perturbations. (Knapp-USGS) W74-09220

#### HIGH-RESOLUTION ANALYSES OF REFRACTORY ORGANIC CONSTITUENTS IN AQUEOUS WASTE EFFLUENTS.

Oak Ridge National Lab., Tenn.  
R. L. Jolley, W. W. Pitt, Jr., and C. D. Scott.  
Available from NTIS, Springfield, Va. 22151 as CONF-730401-3 - Price \$3.00 printed copy; \$1.45 microfiche. 1973. 23 p, 6 fig, 2 tab, 16 ref.

Descriptors: \*Chemical analysis, \*Organic matter, \*Waste water(Pollution), \*Pollutant identification, \*Chromatography, \*Anion exchange, Flame photometry, Spectrophotometry.

Organic contaminants in domestic sanitary waste treatment plant effluents may be analyzed using high-resolution analytical systems developed at the Oak Ridge National Laboratory. These analyzers utilize high-pressure, anion exchange chromatography for separation of molecular constituents in effluent concentrates. The separated compounds are detected using UV-photometry, cerate oxidimetry, or phenol-sulfuric acid colorimetry for UV-absorbing, oxidizable, or carbohydrate constituents respectively. Over 100 constituents are separated and detected from a typical domestic primary sewage treatment plant effluent. More than 50 constituents are separated from a typical domestic secondary sewage treatment plant effluent; of these, 9 were identified and 8 quantified. Preliminary results using the analyzers to study the effects of chlorination on sewage effluents indicate that several stable chlorinated organic residuals are formed during chlorination. (Knapp-USGS) W74-09226

#### CHEMICAL COMPOSITION OF WATER SUPPLIES TO NAVAL AND MARINE CORPS AIR STATIONS.

Naval Air Development Center, Warminster, Pa. Materials Engineering Section.  
W. C. Hallow.  
Available from NTIS, Springfield, Va. 22151 as AD-757 335 - Price \$3.00 printed copy; \$1.45 microfiche. Report No. NADC-72260-VT, December 1972. 14 p, 5 fig, 5 tab, 3 ref.

Descriptors: \*Water quality, Aircraft, \*Airports, \*Military reservations, \*Water supply, \*Dissolved solids, \*Chlorides, Texas, California, Treatment facilities.

Identifiers: Aircraft wash-water.

A survey was made of the quality of water supplies at Naval and Marine Corps Air Stations both within the United States and overseas to aid in the design and location of new water rinse facilities for aircraft. In addition to the total dissolved solids (TDS) and chloride content, each water analysis includes the pH, carbonate and noncarbonate hardness, and the concentration of several ions found in the water. Only two factors, the TDS and the chloride concentrations, need to be considered in determining if a water supply is suitable for rinsing aircraft. Eleven air stations in Texas and in southern California report high TDS and chloride concentrations. Five of the 13 overseas stations reported have high TDS and chloride concentrations. The water supply at overseas stations is generally comparable to stations within the Continental United States. (Knapp-USGS) W74-09227

ANALYSIS OF NATURAL SYSTEMS, Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div. For primary bibliographic entry see Field 5C. W74-09234

#### AERIAL RADIOLOGICAL MEASURING SURVEY OF THE AREA SURROUNDING THE DRESDEN NUCLEAR POWER STATION, MORRIS, ILLINOIS, SEPTEMBER 1968.

EG and G, Inc., Las Vegas, Nev.  
P. K. Boyns, and M. D. Severt.  
Available from NTIS, Springfield, Va., as ARMS 68.6.8; \$5.45 per copy, \$1.45 microfiche. Report No. ARMS-68.6.8, December 1973. 79 p, 60 fig, 5 tab.

Descriptors: \*Nuclear powerplants, \*Monitoring, \*Surveys, Assay, Environment, Air pollution, Water pollution, Soil contamination, Fallout, Effluent, Rivers, Marshes, Remote sensing, Meteorology, \*Illinois, \*Remote sensing.

The Aerial Radiological Measuring System (ARMS), operated for the U.S. Atomic Energy Commission, was used to perform surveys of several operational and non-operational reactor sites during the summer months of 1968. The data collected on these surveys included aerial photographs of the installations. Aerial radiation survey data includes exposure rates normalized to 3 feet above the ground plus gamma ray spectral charts, effluent characterization for operational sites (intensity rates and isotope constituents), and pertinent descriptive information of the installation. This report contains the data for the survey of the Dresden Nuclear Power Station and surrounding area, including an effluent plume track. (Houser-ORNL) W74-09250

### 5B. Sources Of Pollution

DECHLORINATION OF DDT BY AEROBACTER AEROGENES, Bureau of Sport Fisheries and Wildlife, Denver, Colo. Fish-Pesticide Research Lab. G. Wedemeyer. Science, Vol 152, No 3722, p 647, April 29, 1966.

Descriptors: \*Biodegradation, Pesticides, Bacteria, \*DDT, \*DDD, Oxygen requirements, Metabolism, Inhibition, Iron, \*Pesticide residues. Identifiers: \*Dechlorination, \*Aerobacter aerogenes.

Dechlorination of DDT to DDD in higher animals requires the presence of molecular oxygen, but in microorganisms the presence of oxygen hinders dechlorination. In cell-free preparations of Aerobacter aerogenes, the use of selected metabolic inhibitors indicated that reduced Fe(II) cytochrome oxidase was responsible for DDT dechlorination. This finding may possibly explain the persistence of DDT residues in soils and sediments. W74-08739

ECOSYSTEM OF THE SALTON SEA, California State Univ., Long Beach. Dept. of Microbiology. For primary bibliographic entry see Field 4A. W74-08752

PENETRABILITY AND HYDRAULIC CONDUCTIVITY OF DILUTE SULFURIC ACID SOLUTIONS IN SELECTED ARIZONA SOILS, Arizona Univ., Tucson. Dept. of Soils, Water, and Engineering. For primary bibliographic entry see Field 2G. W74-08765

SALINITY PROBLEMS OF THE SAFFORD VALLEY: AN INTERDISCIPLINARY ANALYSIS, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. A. B. Muller.

In: Hydrology and Water Resources of Arizona and the Southwest, Proceedings of the 1973 meetings of the Arizona Section-Amer. Water Resources Assn., and the Hydrology Section-Arizona Academy of Science, Tucson, p 136-144, (1973). 5 fig, 9 ref.

Descriptors: \*Salinity, \*Water quality, \*Leakage, \*Agricultural runoff, \*Crop production, Cotton, Alfalfa, \*Arizona, Aquifer systems, Artesian aquifers, Deep wells, Salts, Salt tolerance, Water pollution sources, Irrigation water, Water quality control. Identifiers: \*Safford Valley(Ariz).

A change in groundwater quality, averaging approximately +0.129 millimhos electrical conductivity and +35 ppm chloride per year, has been documented between 1940 and 1972 with data from 10 long-term sample wells in the Safford Valley of southeastern Arizona. Decrement of water quality of the surficial aquifer can be attributed to 4 major mechanisms: An increase in salinity because of saline water leakage from the artesian aquifer, stimulated by pumping-caused reduction of confining pressure and by the puncture of the cap beds by deep wells; Water reaching the aquifer from natural recharge, if passed through soluble beds; Lateral movement of water through similar deposits, as well as Concentration and infiltration of agricultural water. An economic analysis of the area, based on modeling of representative farm units and projected salinity trends for a significant time beyond the limits of prediction, shows that cotton will remain an economic crop but that alfalfa will no longer be grown by 2040. Methodology described indicates low pumping influences salinity changes. Salinity controls for the area are outlined. (Muller-Arizona) W74-08769

HOUSEHOLD WASTEWATER CHARACTERIZATION, Baxter and Woodman, Inc., Crystal Lake, Ill. K. Ligman, N. Hutzler, and W. C. Boyle. Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 100, No EE1, p 201-213, February 1974. 9 tab, 46 ref.

Descriptors: \*Waste water, \*Surveys, \*Suspended solids, \*Waste disposal, Sampling, Domestic wastes, Biochemical oxygen demand, Water quality, \*Pollutant identification.

The types of waste waters generated in a domestic household and their respective waste water characteristics were defined through the use of a waste water generation survey, a waste water sampling survey, and literature reviews. Based on data collected, a simulated waste loading was adopted for use in waste water treatment and disposal studies. The average four person household uses 190 gallons of water a day generating 0.695 lb/day BOD5 and 0.797 lb/day of suspended solids. Current research efforts employing this simulated waste water loading will define the limitations and operational requirements of given unit processes to meet a requisite water quality for ultimate disposal. (Merritt-FIRL) W74-08770

THORIUM ISOTOPE CONTENT IN RIVER WATER IN JAPAN, Meteorological Research Inst., Tokyo (Japan). Y. Miyake, Y. Sugimur, and T. Yasujima. Papers in Meteorology and Geophysics, Vol 24, No 1, p 67-73, March 1973. 1 fig, 6 tab, 6 ref.

Descriptors: Rivers, \*Isotope studies, \*Radioisotopes, \*Radioactive wastes, Investigations, Analysis, Analytical techniques, Water pollution. Identifiers: \*Japan, \*Thorium.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

The concentrations of thorium isotopes Th232, Th230, and Th238 were determined in the river water collected at 10 main rivers in Japan. The concentration of dissolved Th232 in river water was one order of magnitude higher than that in the Pacific surface waters. The weighted averages were 2.7 times 10 to the minus 8th power g/liter for Th232 and 2.8 times 10 to the minus 13th power g/liter for Th230. The constancy in Th232 and Th230 concentration with time was observed, but the concentration of Th238 in river water was quite variable. Accordingly, the Th238/Th232 activity ratio showed a wide range of variations from 37 to 0.65 during the period of study. (Merritt-FIRL)

W74-08772

#### PHOSPHORUS AND CARBON IN LAKE POLLUTION,

Basf-Wyandotte Chemical Corp., Mich.  
For primary bibliographic entry see Field 5C.  
W74-08775

#### FACTORS AFFECTING THE PERSISTENCE OF PESTICIDES IN THE SOIL,

Rothamsted Experimental Station, Harpenden (England).  
C. A. Edwards.  
Chemistry and Industry, No 5, p 190-193, March 2, 1974. 1 fig, 48 ref.

Descriptors: \*Insecticides, \*Soil contamination, Soil chemical properties, \*Soil management, Soil environment, Temperature, Rainfall, Soil moisture, Soil physical properties, Soil types, \*Pesticide residues, \*Path of pollutants.

The factors that influence the persistence of organochlorine insecticides in soil can be separated into chemical, soil, environmental, and human factors. Under chemical characteristics the most important factor is the intrinsic stability of the chemical with the solubility of the pesticide being of considerable influence. Soil type and particle size as well as the amount of organic matter in a soil greatly affect how long the insecticide will remain. The most important environmental factors include temperature, rainfall, and soil moisture. Factors such as cultivation, weathering of the soil surface, and plant selection can influence the persistence of insecticides relative to the management of the soil. (Sandoski-FIRL)

W74-08793

#### THE INVESTIGATION OF BIODEGRADABILITY OF BRANCHED NONYL PHENOL ETHOXYLATES,

Swedish Water and Air Pollution Research Lab., Stockholm.  
For primary bibliographic entry see Field 5D.  
W74-08798

#### EFFECT OF LONG-TERM MANAGEMENT ON PHYSICAL AND CHEMICAL PROPERTIES OF THE COSHOCTON WATERSHED SOILS,

Agricultural Research Service Coshocton, Ohio. North Appalachian Experimental Watershed.  
For primary bibliographic entry see Field 4D.  
W74-08813

#### LEACHING REQUIREMENT STUDIES: SENSITIVITY OF ALFALFA TO SALINITY OF IRRIGATION AND DRAINAGE WATERS,

Agricultural Research Service, Riverside, Calif. Salinity Lab.  
For primary bibliographic entry see Field 3C.  
W74-08815

#### CONTENT OF PLUTONIUM IN RIVER WATER IN JAPAN,

Meteorological Research Inst., Tokyo (Japan). Y. Miyake, Y. Sugimura, and K. Saruhashi.

Papers in Meteorology and Geophysics, Vol 24, No 1, p 75-78, March, 1973. 1 fig, 1 tab, 6 ref.

Descriptors: Rivers, \*Radioactive wastes, Fallout, Water pollution, Investigations, Waste disposal, Water pollution sources.  
Identifiers: \*Japan, \*Plutonium.

The content of plutonium in the water of eight main rivers in Japan was determined. The average value of the total content of plutonium is 0.0014pCi/liter in which .0004 pCi/liter is contained in the suspended matter. The annual runoff plutonium is only 0.12% of the accumulated plutonium on land. This suggests that the fallout plutonium is firmly adsorbed on soil surface and is difficult to leach out. (Merritt-FIRL)

W74-08821

#### SIMULATION OF DISSOLVED OXYGEN PROFILE,

Worcester Polytechnic Inst., Mass. Dept. of Mathematics.  
G. C. Sornberger, and K. Keshavan.

Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 99, No EE4, Paper 9943, p 479-488, August 1973. 3 fig, 6 ref, append. OWRR C-3027(3674)(2).

Descriptors: \*Dissolved oxygen, \*Oxygen demand, \*Simulation analysis, Mathematical models, Oxygen sag, Stochastic processes, \*Thermal pollution, \*Path of pollutants, Variability.

A stochastic mathematical model describes the probability distribution of dissolved oxygen in streams which have received an input of both thermal and organic pollution. The stochastic model is simulated under conditions of constant and variable temperature, and the results of the simulation are compared with the mean values predicted by recent deterministic models. The simulation provides an estimate of the variability in the DO level to be expected at different points as well as a means of generating typical oxygen sag curves for a stream. (Knapp-USGS)

W74-08823

#### THE DEVELOPMENT OF PHOSPHATE FREE HEAVY DUTY DETERGENTS,

Gillette Co. Research Inst., Rockville, Md.  
For primary bibliographic entry see Field 5C.  
W74-08830

#### INVESTIGATION OF SURFACE FILMS - CHESAPEAKE BAY ENTRANCE,

Virginia Inst. of Marine Science, Gloucester Point.  
For primary bibliographic entry see Field 5A.  
W74-08831

#### NITROGENOUS COMPOUNDS IN THE ENVIRONMENT,

Environmental Protection Agency, Washington, D.C. Hazardous Materials Advisory Committee. Copy Available from GPO Sup Doc, \$2.20; microfiche from NTIS as PB-232 959 \$1.45. Environmental Protection Agency Report EPA-SAB-73-001, December 1973, 187p.

Descriptors: \*Feed lots, \*Waste water treatment, Landfills, Ecology, Water pollution, Water pollution effects, \*Water pollution control, Groundwater, Run-off, Urban areas, Sewage, Industrial wastes, Sanitary engineering, Air pollution, Nitrites, \*Nitrogen compounds, Fertilizers, Wastes, Food supply, \*Farm wastes.  
Identifiers: Sanitary landfill leachate, Nitrosamines.

This report is a series of papers on the sources and methods of control and the environmental and health effects of nitrogenous compounds. Diverse aspects of municipal and industrial sources are

discussed—waterborne, atmospheric, agricultural, and industrial processes generating nitrogenous compounds. Attention is given to nitrogenous materials in waste and surface waters, efficiency of sewage treatment, effectiveness of the conventional BOD test, and the contribution of urban runoff and landfill leakage to the overall nitrogen load in the environment. Concentrations, sources, sinks, the transformation of nitrogenous materials in the lower atmosphere, control measures for stationary and mobile sources, retrofit systems for used cars, and new engine systems are reviewed. Plant nutrients, including fertilizers, and animal wastes are considered. The growing problems resulting from concentrated centralized livestock feedlots and methods of control are pointed out. Nitrogen is discussed as a nutrient essential to living organisms and as a toxicant within the aquatic environment. The carcinogenicity of nitrosamines and their precursors is described as a potential danger to health. Individual nitrogenous compounds are appropriately identified through the report. Analytical procedures for the identification and quantification of nitrogenous compounds are reviewed. Presented are the major concerns regarding nitrogenous compounds in the environment as these related to the following Environmental Protection Agency activities: research, monitoring, and regulation. (Malone-EPA)

W74-08835

#### LARGE-SCALE MASS BALANCE FOR LEAD IN SOUTHERN LAKE MICHIGAN,

Illinois Univ., Chicago. Dept. of Energy Engineering.  
A. C. Cogley.

Available from the National Technical Information Service as PB-232 956 \$3.00 in paper copy, \$1.45 in microfiche. Illinois University, Urbana. Water Resources Center Research Report No 85, December 1973. 18 p, 1 fig, 1 tab, 20 ref. OWRR A-057-ILL (1), 14-31-0001-3813.

Descriptors: \*Lake Michigan, \*Aerosols, \*Lead, Air pollution, \*Path of pollutants, \*Illinois, Dispersion, Model studies, Turbulent boundary layers.  
Identifiers: \*Mass-balance(Lead), \*Atmospheric transport, Chicago area(III.)

A large-scale, order-of-magnitude mass balance for lead in the near field of Chicago (the source) is presented. Both experimental data and simple physical modeling are used to estimate the transport of lead from the major sources to the near-field sinks of Southern Lake Michigan, its watershed soil, and the surroundings (losses from the system under question). The results show that atmospheric transport of lead aerosols to a sink like Lake Michigan is about two orders of magnitude greater than other transport mechanisms. To perform a detailed (small-scale) mass balance for lead, in support of the large-scale results, a complete model of atmospheric, aerosol transport and deposition is necessary and dominant. Although much work has been done on (free) turbulent dispersion of aerosols and aerosol deposition through precipitation, little is known about the dry deposition of aerosols from a turbulent boundary layer. An aerosol, turbulent dispersion model with a realistic boundary condition at the fluid-ground interface needs to be developed. A coordinated experimental program for measuring (dry) aerosol flux to the ground (and Lake) should be initiated.

W74-08836

#### NITROGEN: A PROBLEM OF DECREASING DILUTION,

Imperial Coll. of Science and Technology, London (England). Dept. of Mathematics.  
R. Scorer.

New Scientist, Vol 62, No 895, p 182-184, April 25, 1974. 2 fig.

Descriptors: \*Nitrogen, Rivers, \*Nitrates, Human populations, Environmental effects, Potable water, Water pollution sources.  
Identifiers: Nitrogen pollution, \*Thames River(U.K.), Lee River(U.K.), United Kingdom.

Nitrogen pollution levels in the Thames and Lee rivers in Great Britain have risen due to population pressures. Drinking water must be kept under 11.3 mg of nitrogen per liter in order to be potable for babies. Adult limits are about 20 mg nitrogen per liter. The use of river water in towns and the population served by sewage works have both increased. An additional problem is warm winters, such as 1973-1974, where a greater fraction of the waste became nitrate, rather than going into the air as ammonia. (Prague-FIRL)  
W74-08864

**ENVIRONMENTAL PROTECTION AND ENERGY CONSERVATION GO HAND-IN-HAND.**  
Coal Age, Vol 79, No 4, p 113-116, April, 1974. 2 fig, 2 tab.

Descriptors: \*Energy, \*Environmental effects, \*Mining, Conservation, Industrial wastes, Air pollution effects, Standards.  
Identifiers: \*Environmental protection, Industrial pollution, Auto emissions standards.

Major energy-environmental interfaces and problems are discussed. Mining industries, especially base metal producers such as aluminum, copper, lead, zinc, are viewed by EPA as major sources of industrial pollution. The impact of new 'clean' energy sources is proposed. Auto emissions standards are a controversial issue, both for tuning up old cars and for the prohibitive consumer costs of anti-pollution devices for new models. Shifting patterns in electricity use and the need for energy conservation, including drastic changes legislated by Congress are also noted. (Prague-FIRL)  
W74-08865

**DETERMINING THE BIODEGRADABILITY OF ORGANIC COMPOUNDS.**  
Effluent and Water Treatment Journal, Vol 14, No 3, p 161, March, 1974.

Descriptors: \*Instrumentation, \*Oxygen demand, \*Pollutants, \*Organic compounds, \*Biodegradation, Effluents, Water pollution control, Measurement, Surface waters, Industrial wastes, Pollutant identification.  
Identifiers: \*Organic carbon analyser, Model 915 TOC Analyser, Water pollution control plants.

Organic carbon in aqueous solution or suspension may be measured by catalytically oxidizing it to carbon dioxide, with a Model 915 TOC Analyser by Beckman Instruments. One application of the total organic carbon analyser is the determination of degradability of various organics by a given culture in the activated sludge treatment process. The process incorporates the aerobic oxidation of organic compounds to simple, harmless inorganics such as carbon dioxide, water, nitrates, sulphates, and cellular organic matter. Because widespread requirements for determining organic pollution of water are increasing, this measurement of organic carbonaceous matter as a major oxygen-demanding pollutant is important. Total organic carbon analyser measurement is rapid and produces duplicate results on duplicate samples. The process is applicable for measurement of effluents from water pollution control plants, industrial waste treatment plants, and the measurement of organics in surface waters. (Prague-FIRL)  
W74-08867

**BORON RELEASE FROM DEIONIZERS.**  
California Univ., Los Angeles. Dept. of Environmental Horticulture.  
J. L. Paul, and W. F. Thornhill.

Industrial Water Engineering, Vol 11, No 1, p 6, January/February, 1974.

Descriptors: \*Boron, \*Toxicity, \*Plant pathology, Water quality, \*Irrigation, Ion exchange, Distillation.  
Identifiers: \*Deionized water.

The release of boron from deionized water and its pollution and toxicity effects are discussed. When water is used for irrigation, it is necessary to consider boron concentration in assessing water quality because boron is toxic to plants at 1 ppm or more in irrigation water. Deionized water, produced from a mixed bed unit, was used for irrigating greenhouse plants and scattered but recurring cases of boron toxicity were noted. Samples of deionized water collected just before and during breakthrough and analyzed for boron, pH, and electrical resistance showed that boron reached a maximum concentration of 15 mg/liter. Most plant species die if irrigated continually with this concentration. (Merritt-FIRL)  
W74-08873

**ENVIRONMENTAL RADIATION DOSE CRITERIA AND ASSESSMENT-PATHWAY MODELING AND SURVEILLANCE.**  
Brookhaven National Lab., Upton, N.Y. Health Physics and Safety Div.  
A. P. Hull.  
IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 491-495, February, 1974. 2 fig, 3 tab, 24 ref.

Descriptors: \*Radiation, \*Nuclear powerplants, \*Safety, Nuclear physics, Radioactive wastes, Measurements, \*Radioactivity, Monitoring, Nuclear reactors, \*Path of pollutants.  
Identifiers: \*Environmental radiation doses.

The development of environmental radiation dose criteria and assessment through both pathway modeling and environmental surveillance are discussed. Considerable effort has been devoted to this end since the first utilization of nuclear reactors in the United States in the 1940's and particularly since the advent of civilian nuclear power reactors. The Atomic Energy Commission has issued a Safety Guide calling for considerable refinement in the measuring and reporting of effluents from nuclear power plants, and has only recently issued a counterpart dealing with the measuring and reporting of radioactivity in the environs of nuclear power plants. The EPA has also recently issued a guide for the surveillance of environmental radioactivity. Currently, power reactor operators are being required by the AEC Regulatory Staff to conduct detailed, sensitive environmental surveillance at levels consistent with proposed concentration limits. (Merritt-FIRL)  
W74-08875

**INSTRUMENTATION AND ENVIRONMENTAL RADIATION ASSESSMENT SYSTEMS.**  
Office of Radiation Programs, Washington, D.C.  
C. E. Peters.  
IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 470-477, February, 1974. 7 fig, 1 tab, 10 ref.

Descriptors: \*Radiation, \*Monitoring, \*Instrumentation, Nuclear powerplants, \*Surveys, Model studies, Water transfer, Radioisotopes.  
Identifiers: Environmental radiation doses.

The field of radiation protection monitoring was surveyed and those applications requiring improved instrumentation or monitoring systems are identified. The application of most pressing concern are emergency response monitoring systems and systems to monitor the radiation exposure in the vicinity of nuclear power facilities. The increasing need for calculating the doses from sources of radiation exposure has generated two

trends that may be of importance to the future development of nuclear instrumentation and/or monitoring systems. One trend is the increasing use of models, such as air and water transport models, to calculate the movement of radionuclides and subsequently the doses. The other trend is the increasing demand for specific radionuclide concentration measurements, which can be used for calculating dose, rather than measurements of gross activity. (Merritt-FIRL)  
W74-08876

**DISTRIBUTION OF PHOSPHATES IN LAKE MARIUT, A HEAVILY POLLUTED LAKE IN EGYPT.**  
Alexandria Univ. (Egypt). Dept. of Oceanography.  
M. A. H. Saad.  
Water, Air, and Soil Pollution, Vol 2, No 4, p 515-522, December, 1973. 3 fig, 28 ref.

Descriptors: \*Lakes, \*Phosphates, \*Distribution patterns, Seasonal, Investigations, Water pollution, \*Environmental effects, Water pollution sources, \*Path of pollutants.  
Identifiers: \*Egypt(Lake Mariut), Phosphate distribution.

Because of an increase in human population and industry around Lake Mariut, the lake has changed into a markedly eutrophic state. Severe pollution is mainly responsible for the decrease in the total fish production from 9,977.815 kg in 1961 to 1,490,600 kg in 1969. This lake continuously receives great amounts of untreated sewage and industrial wastes. Huge quantities of drainage waters rich in phosphate fertilizers enter the lake as well. The concentrations of phosphates are also increased by the liberation of autochthonous phosphates from the decomposition of massive amounts of dead phytoplankton and the stirring up of the bottom muds by wind action, which accelerates the release of adsorbed phosphates from the mineral particles. The phosphate values for Lake Mariut were several times higher than surrounding Egyptian lakes, due to the aforementioned factors. (Prague-FIRL)  
W74-08881

**WASTE ACCUMULATION ON A SELECTED DAIRY CORRAL AND ITS EFFECT ON THE NITRATE AND SALT OF THE UNDERLYING SOIL STRATA.**  
California Univ., Riverside. Dept. of Soil Science and Agricultural Engineering.  
A. C. Chang, D. C. Adriano, and P. F. Pratt.  
Journal of Environmental Quality, Vol 2, No 2, p 233-237, April-June, 1973. 5 fig, 3 tab, 9 ref.

Descriptors: \*Water pollution sources, Animal wastes(Wildlife), \*Leaching, Nutrient removal, \*Dairy industry, Nitrogen, \*Nitrates, \*California, Soils, Salts.  
Identifiers: \*Chino-Corona(Calif).

A corral was selected from a typical Chino-Corona, California area dairy to study waste accumulation and distribution on corral surfaces and to determine its effect on underlying soil strata. Waste deposited on the surface tended to accumulate in a small area of the corral; as much as 57% of the waste was in an area equaling 30% of the total corral surface. Considerable decomposition of organic matter and nitrogen loss took place during accumulation; however, collected waste samples were relatively unstable and subject to further decomposition. After a long period of dairy operations, leaching of nitrates, chlorides, and organic matter into soils was substantial. The same order of magnitude of leaching of chloride and organic carbon occurred throughout the entire corral surface. The amount of nitrate underneath the area of heavy waste accumulation was less than that in the other part of the corral. Future improvement in dairy waste management should take this into consideration in order to minimize its potential cause of ground water pollution. (Skogerboe-Colorado State)

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

W74-08921

#### NUTRIENT BALANCES FOR THE EVALUATION OF NUTRIENT SOURCES IN WATER QUALITY MANAGEMENT,

Department of the Environment, Ottawa (Ontario). Water Quality Branch.

R. H. Peters.

Water Resources Bulletin, Vol 9, No 1, p 49-53, February, 1973. 2 fig, 3 tab, 1 ref.

Descriptors: \*Water pollution sources, Water quality, Water quality control, \*Nutrients, Riverflow, River systems, Leaching, \*Canada, \*Nitrogen, \*Phosphorus, \*Path of pollutants.

Identifiers: \*Qu'Appelle River basin(Sask).

The methodology for a nutrient balance to evaluate the sources and distribution of nutrients in a small river basin is described. Loadings for total nitrogen and phosphorus are calculated from measured nutrient concentration and river discharge data. Using a special retrieval program and a data storage and processing system, loadings are accumulated over a given time period to allow for time of passage through the basin and seasonal changes in nutrient distribution. Nutrient balances are made with the accumulated loadings to obtain the relative contribution of each nutrient source and the retention of nutrients within the basin through sedimentation and aquatic growth. The methodology has been used to study nutrients in the Qu'Appelle River Basin, Saskatchewan, Canada. (Skogerboe-Colorado State)

W74-08928

#### RATIONALE FOR OPTIMUM NITROGEN FERTILIZATION IN CORN PRODUCTION,

Agricultural Research Service, Beltsville, Md.

Soils Lab.

For primary bibliographic entry see Field 3F.

W74-08929

#### DISTRIBUTION OF SELECTED TRACE METALS IN SOUTHERN LAKE MICHIGAN AND LOWER GREEN BAY,

Illinois Univ., Urbana. Dept. of Civil Engineering.

H. V. Leland, and N. F. Shimp.

Available from the National Technical Information Service as PB-232 971; \$3.25 in paper copy, \$1.45 in microfiche. Illinois Water Resources Center, Urbana, Research Report No 84, April 1974. 28 p, 9 fig, 3 tab, 24 ref. OWRR A-052-ILL(2). 14-31-0001-3213.

Descriptors: \*Lake Michigan, \*Heavy metals, \*Trace elements, Sediment-water interfaces, \*Path of pollutants, \*Distribution patterns, \*Lake sediments.

Identifiers: \*Metal transport, Water-sample storage, Sediment-water interaction, \*Green Bay, Trace metals.

The distribution of selected trace metals in water, suspended matter and sediments of southern Lake Michigan and in surficial sediments of lower Green Bay is described. Accumulations of As, Br, Cr, Cu, Hg, Pb, and Zn in fine-grained surficial sediments of southern Lake Michigan, apparently determined by patterns of sediment deposition, correlate closely with sediment concentrations of organic carbon and iron. Organic carbon concentrations of surficial sediments are more highly correlated with concentrations of Cu, Pb and Zn in surficial sediments of lower Green Bay than are either Fe or Mn contents. Mean concentrations of trace metals in suspended matter near the sediment-water interface of southern Lake Michigan equal or exceed amounts in surficial sediments. Horizontal (geographic) and vertical distributions of concentrations of nine trace metals (Cd, Cr, Co, Cu, Fe, Pb, Mn, Ni and Zn) in waters of southern Lake Michigan were examined during the period June-October, 1971. Distributions of Cu, Fe, Pb and Zn in filtered lake water are presented. Metal

concentrations are typically highest near areas of industrialization and major tributary embouchment. Concentrations of Cu, Fe, Pb and Zn in nearshore areas of southern Lake Michigan are typically higher than concentrations in offshore waters, but this trend is inconsistent.

W74-08934

#### QUANTIFICATION OF POLLUTANTS IN AGRICULTURAL RUNOFF,

South Dakota State Univ., Brookings. Dept. of Civil Engineering.

J. N. Dornbush, J. R. Andersen, and L. L. Harms.

Copy Available from GPO Sup Doc as EPI.23:660/2-74-005, \$1.90; microfiche from NTIS as PB-233 134, \$1.45. Environmental Protection Agency, Technology Series Report EPA-660/2-74-005, February 1974. 149 p, 24 fig, 15 tab, 73 ref. EPA Project R800400. Contract 68-01-0030.

Descriptors: Surface runoff, \*Agricultural runoff, Erosion, \*Nutrients, Phosphorus, \*Nonpoint pollution source, Chemistry, Sediments, \*Water pollution sources, Pesticides, Bacteria, \*South Dakota, Bioindicators, Rainfall, Snowmelt.

Identifiers: \*Runoff pollutants.

Surface runoff from snowmelt and rainfall in eastern South Dakota was measured during a three year period. The size of the research sites ranged from 7.18 to 18.69 acres, and all sites had crops of corn, oats, pasture or hayland. Composite samples of the runoff were used for various chemical, physical and biological determinations. Runoff samples from 108 snowmelt events and 36 rainfall events were collected. Equipment fabrication and installation resulted in some incomplete data for the initial year, but successful monitoring of each runoff event was accomplished thereafter. Sediment losses were considerably lower than anticipated. Pesticide concentrations were low in both water and sediment samples, and were usually less than the analytical test limits. Coliform and fecal levels were consistently greater than accepted surface water quality criteria. Most of the nutrients were found to be soluble and/or associated with snowmelt runoff. (EPA)

W74-08942

#### DEVELOPMENT OF PREDICTIONS OF FUTURE POLLUTION PROBLEMS,

Battelle-Columbus Labs., Ohio.

J. E. Flinn, and R. S. Reimers.

Copy Available from GPO Sup Doc as EPI.23:600/5-74-005, \$2.40; microfiche from NTIS as PB-233 117, \$1.45. Environmental Protection Agency, Socioeconomic Studies Series Report EPA-600/5-74-005, March 1974. 207 p, 7 fig, 41 tab. EPA Program Element 1HA095. Contract 68-01-1837.

Descriptors: \*Pollutants, Pollutant identification, Air pollution, \*Water pollution sources, Strip mines, \*Forecasting, Land use.

Identifiers: \*Future pollution problems, Mine pollution, Toxic chemicals, Fine particulates, Radiation problems.

The report describes the results of a program to identify, rank and project short- and intermediate-term future pollution problems. Identification was accomplished using three independent search approaches based on industrial production, environmental, and societal trends and activity. Primary emphasis was placed on the environmental trends as gleaned from EPA, Battelle, literature, and other sources. An initial list of problems was compiled with specific stressors identified with each. Nine ranking factors were devised to select ten 'most serious' problems from the initial list. The factors included: persistence; mobility/pervasiveness; environmental, technological, social, and political complexity; physiological risk; research needs; and bulk or volume of the pollutant. The ten problems selected by this method were further ranked in order of relative im-

portance. The ten selected problems in rank order are as follows: (1) Impacts of New Energy Initiatives; (2) Geophysical Modifications of the Earth; (3) Trace Element (Metal) Contaminants; (4) Proliferating Hazardous and Toxic Chemicals; (5) Emissions from New Automobile Fuels, Additives, and Control Devices; (6) Disposal of Waste Sludges, Liquids, and Solid Residues; (7) Critical Radiation Problems; (8) Fine Particulates; (9) Expanding Drinking Water Contamination; and (10) Irrigation (Impoundment) Practices. Five to ten year projections were made of the ten problems which resulted. (EPA)

W74-08946

#### THE NUCLEAR FUEL CYCLE -- A SURVEY OF THE PUBLIC HEALTH, ENVIRONMENTAL AND NATIONAL SECURITY EFFECTS OF NUCLEAR POWER,

Union of Concerned Scientists, Cambridge, Mass.

For primary bibliographic entry see Field 5C.

W74-08947

#### NUCLEAR FUEL REPROCESSING: RADIOLOGICAL IMPACT OF WEST VALLEY PLANT.

For primary bibliographic entry see Field 5C.

W74-08953

#### HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM -- QUARTERLY SUMMARY REPORT -- DECEMBER 1, 1973 THROUGH MARCH 1, 1974,

Health and Safety Lab. (AEC), New York.

E. P. Hardy, Jr.

Available: NTIS, Springfield, Va., as Rept. No. HASL-281, \$7.60 per copy, \$1.45 microfiche. Report No. HASL-281, April 1974. 277 p, 71 fig, 36 tab, 91 ref, 1 bibli.

Descriptors: \*Monitoring, \*Sampling, \*Fallout, \*Data collections, \*Nuclear explosions, \*Strontium, \*Cesium, Air pollution, Water pollution, Soil contamination, Environment, Trace elements, Air, Milk, Diets, Food chains, Potable water, Assay, Public health.

Identifiers: Weapons testing, China, France, Stratosphere, \*Concentration.

Current data are presented from the HASL Fallout Program and the Technical University of Wrocław, Poland. The initial section of the report consists of interpretive reports and notes on the termination of aircraft sampling in the stratosphere; stratospheric radioactivity from Chinese and French nuclear tests; concentrations of Sr-90 and Cs-137 in environmental samples from Poland; stratospheric radionuclide inventories; and fallout of trace metals in New York City. Subsequent sections include tabulations of radionuclide levels in fallout, surface air, stratospheric air, milk, diet, tap water, and human bone. A bibliography of recent publications related to radionuclide studies is also presented. (See also W74-08955 and W74-08956) (Houser-ORN)

W74-08954

#### RADIOACTIVITY DISTRIBUTION IN THE STRATOSPHERE FROM CHINESE AND FRENCH HIGH YIELD NUCLEAR TESTS (1967-1970),

National Oceanic and Atmospheric Administration, Silver Springs, Md. Air Resources Labs.

K. Telegadas.

In: Report No. HASL-281, p 1-3 to 1-112, April 1974. 49 fig, 14 tab, 48 ref.

Descriptors: \*Nuclear explosions, \*Radioactivity, \*Distribution, \*Meteorology, \*Measurement, \*Assay, Monitoring, Air pollution, Fallout, Water pollution, Degradation, Withdrawal, Summer, Autumn, Winter, Radioisotopes, Air pollution, Water pollution, Remote sensing.

Identifiers: France, China, Stratosphere, Concentration.

Radioactivity concentrations and ratios in stratospheric air samples up to 30 km described the latitudinal and vertical spread of debris from a stratospheric source. China detonated 3 MT devices at 40 deg N, 90 deg E on June 17, 1967; December 27, 1968; September 29, 1969, and October 14, 1970. Estimates of the initial source distribution for all four tests and the depletion of the resulting stratospheric burdens are discussed. Meteorological data pertinent to the four high yield tests, such as an estimate of the temperature profile at the time of detonation and the Northern Hemisphere constant level stratospheric maps up to 50 mb were used to explain, in part, the observed changes in the latitudinal distribution of radioactivity following each test. Common features of the radioactivity patterns for the four Chinese tests have been incorporated into composite pictures of the seasonal latitudinal distribution of radioactivity following summer, fall, and winter nuclear tests. (See also W74-08154) (Houser-ORNL) W74-08955

**HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM -- QUARTERLY SUMMARY REPORT -- DECEMBER 1, 1973 THROUGH MARCH 1, 1974, (APPENDIX),** Health and Safety Lab. (AEC), New York. For primary bibliographic entry see Field 5A. W74-08956

**ENVIRONMENTAL ASPECTS OF PLUTONIUM -- A SELECTED, ANNOTATED BIBLIOGRAPHY.** Oak Ridge National Lab., Tenn. Available: NTIS, Springfield, Va., as Rept. No. ORNL-EIS-72-21; \$13.60/copy; \$1.45 microfiche. Report No. ORNL-EIS-72-21, September 1972. 391 p, 785 ref, 5 indexes.

Descriptors: \*Bibliographies, Publications, \*Plutonium, \*Environment, Air pollution, Water pollution, Water pollution sources, Soil contamination, Ecology, Ecosystems, \*Abstracts, Computer programs, Data storage and retrieval.

This bibliography is the first publication of the Environmental Plutonium Data Base, which is being assembled for computer storage and retrieval. The abstracts report observations and measurement methods about or applicable to plutonium in the environment. The subjects of central concern were the movement of plutonium through the environment, particularly that of the Nevada Test Site with emphasis on its availability to man. Related material, such as biological effects of plutonium, interaction of plutonium with various ecosystems, dispersion of fallout from nuclear explosions, was also included. Subject categories include the mode of input to the environment and its assessment. (See also W74-08958) (Houser-ORNL) W74-08957

**ENVIRONMENTAL ASPECTS OF PLUTONIUM AND OTHER ELEMENTS - A SELECTED ANNOTATED BIBLIOGRAPHY.** Oak Ridge National Lab., Tenn. Available: NTIS, Springfield, Va., as Rept. No. ORNL-EIS-73-21 (Suppl. 1). \$10.60/copy; \$1.45 microfiche. Report No. ORNL-EIS-73-21 (Suppl. 1), August 1973. 491 p, 884 ref, 6 indexes.

Descriptors: \*Bibliographies, Publications, \*Abstracts, \*Environment, \*Plutonium, Americium, Uranium, Water pollution, Water pollution sources, Soil contamination, Ecology, Ecosystems, Path of pollutants, Human population, Public health, Computer programs, Data storage and retrieval.

A supplement to the bibliography (ORNL-EIS-72-21) published by the Environmental Plutonium Data Base Group contains an additional 884

references that have been prepared for computer storage and retrieval. The deposition and movement of plutonium, americium, and uranium and their pathway through terrestrial and aquatic ecosystems to man are emphasized. An effort is made to include numerical data in the abstracts and to refer to relevant tables (in the comment field). Indexes are given for authors, permuted titles, subject categories, keywords, publication description, geographic location, and taxonomy. (See also W74-08957) (Houser-ORNL) W74-08958

**THE INFLUENCE OF LIQUID WASTE DISPOSAL ON THE GEOCHEMISTRY OF WATER AT THE NATIONAL REACTOR TESTING STATION, IDAHO: 1952-1970.** Geological Survey, Idaho Falls, Idaho. Water Resources Div. J. B. Robertson, R. Schoen, and J. T. Barraclough. Available from NTIS, Springfield, Va., as IDO-22053, \$7.60/copy, \$1.45 microfiche. Report No. IDO-22053, February 1974. 243 p, 74 fig, 16 tab, 104 ref.

Descriptors: \*Nuclear powerplants, \*Effluents, \*Radioactive waste disposal, \*Idaho, \*Geochemistry, Hydrology, Meteorology, Surface water, Groundwater, Water pollution, Water pollution sources, Geology, Geohydrology, Groundwater recharge. Identifiers: National Reactor Testing Station (Idaho Falls), \*Snake River (Idaho).

A summarized evaluation is presented of the geology, hydrology, and water geochemistry of the National Reactor Testing Station (NRTS), Idaho and the associated influences of subsurface liquid-waste products discharged from the NRTS facilities. The progressive buildup, distribution, and changes of both radioactive and chemical wastes are analyzed for the total disposal period -- 1952-70. Of principal concern is the fate of wastes discharged from the NRTS in the Snake River Plain aquifer, an extremely large and productive groundwater system underlying the vast eastern Snake River Plain. Since 1952, the NRTS facilities (primarily the Test Reactor Area -- TRA, Idaho Chemical Processing Plant -- ICPP, and the Naval Reactor Facility -- NRF) have discharged 1.6 x 10(10) gallons of liquid waste containing 7 x 10(4) curies of radioactivity and about 1 x 10(8) pounds of chemicals to the subsurface. The discharge has been disposed in wells and seepage ponds. The principal waste products include tritiated water, strontium-90, cesium-137, cobalt-60, sodium chloride, chromates, and heat. Wastes at the NRTS have been distributed in the Snake River Plain aquifer and overlying bodies of perched groundwater according to hydrologic and geochemical controls. (Houser-ORNL) W74-08962

**THE DISTRIBUTION OF COBALT-60 RUTHENIUM-106 AND CESIUM-137 AMONG SUSPENDED AND DISSOLVED PARTICLES IN WHITE OAK LAKE.** Oak Ridge Gaseous Diffusion Plant, Tenn. W. T. Lammers. Available from NTIS, Springfield, Va., as Rept No K-1758; \$4.00 per copy, \$1.45 microfiche. Report No K-1758, October 1968. 20 p, 1 fig, 3 tab, 9 ref.

Descriptors: \*Radioisotopes, \*Radioactive wastes, Water pollution, Assay, Analytical techniques, Centrifugation, \*Cobalt, \*Ruthenium, \*Cesium, Radiochemical analysis, Absorption, \*Distribution, Isotope fractionation, Data collections, \*Tennessee. Identifiers: \*White Oak Lake (Tenn).

White Oak Lake, a small impoundment that receives low level radioactive waste from the operation of the Oak Ridge National Laboratory, was sampled routinely during a 14-month period from November 8, 1966, to January 2, 1968. Each

sample was centrifugally fractionated into selected particulate fractions and a dissolved materials fraction. These fractionations were extracted primarily to determine the feasibility of employing centrifugal techniques for isolating and concentrating waterborne particulate materials for study. In addition, the objective was to establish the relation between quantity, type, and surface- or bio-activity of the particles in a fraction and the accumulation of radionuclides by that fraction. The fractions isolated from samples of White Oak Lake water were subjected to radiochemical analysis. Linear correlations were calculated for several combinations of the data. From this statistical analysis and interpretation, the pattern of uptake and distribution of three radionuclides (Cobalt-60, Ruthenium-106, and Cesium-137) in the aquatic environment is better understood. (Houser-ORNL) W74-08964

**SEPARATION AND ANALYSIS OF NATURAL WATER.** Davidson Coll., Biology Div. For primary bibliographic entry see Field 5A. W74-08969

**ENVIRONMENTAL RADIOACTIVITY IN THE FAROES IN 1972.** Danish Atomic Energy Commission, Risoe Research Establishment. A. Aarkrog, and J. Lippert. Available from NTIS, Springfield, Va., as RISO 292, \$4.00 per copy, \$1.45 microfiche. Report No 292, July 1973. 21 p, 8 fig, 18 tab, 6 ref.

Descriptors: Environment, \*Radioactivity, \*Monitoring, Measurement, \*Fallout, \*Strontium, \*Cesium, Precipitation (Atmospheric), Grasses, Milk, Food, Fish, Vegetable crops, Oceans, Potable water, Aquatic plants, Human population, Diets. Identifiers: \*Faroes.

Measurements of fall-out radioactivity in the Faroes in 1972 are presented. Sr-90 (and Cs-137 in most instances) was determined in regularly collected samples of precipitation, grass, milk, lamb, fish, sea water, bread, and drinking water. In addition, analyses of spot samples of potatoes, sea plants, vegetables, eggs, and human bone were carried out. Estimates of the mean contents of Sr-90 and Cs-137 in the human diet in the Faroes in 1972 are given. (Houser-ORNL) W74-09086

**ENVIRONMENTAL RADIOACTIVITY IN DENMARK IN 1972.** Danish Atomic Energy Commission, Risoe Research Establishment. A. Aarkrog, and J. Lippert. Available NTIS, Springfield, Va., as RISO 291, \$7.00 per copy, \$1.45 microfiche. Report No 291, June 1973. 99 p, 46 fig, 85 tab, 20 ref, 3 append.

Descriptors: Environment, \*Radioactivity, \*Fallout, Measurement, \*Strontium, \*Cesium, Precipitation (Atmospheric), Soils, Groundwater, Oceans, Grasses, Milk, Foods, Potable water, Air, Aquatic plants, Human population, Diets. Identifiers: \*Denmark.

The measurement of fall-out radioactivity in Denmark in 1972 is described. Strontium-90 was determined in samples from all over the country of precipitation, soil, groundwater, sea water, grass, dried milk, fresh milk, grain, bread, potatoes, vegetables, fruit, total diet, drinking water, and human bone. Furthermore Sr-90 was determined in local samples of air, rain water, grass, sea plants, fish, and meat. Caesium-137 was determined in soil, sea water, milk, grain products, potatoes, vegetables, fruit, total diet, and meat, and Cs-137 was measured by wholebody counting in persons from a control group at Risoe. Estimates

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5B—Sources Of Pollution

of the mean contents of radiostrontium and radiocaesium in the human diet in Denmark in 1972 are given. The gamma-background was measured regularly at locations around Riso, at ten of the State experimental farms and in an area in Zealand, one in Jutland where future nuclear power plants might be located, and along the shores of the Great Belt. Regular surveys of environmental samples from the Riso area are included. (Houser-ORNL)  
W74-09087

**ENVIRONMENTAL RADIOACTIVITY IN GREENLAND IN 1972**, Danish Atomic Energy Commission, Riso. Research Establishment.  
A. Aarkrog, and J. Lippert.  
Available from NTIS, Springfield, Va., as Riso 293, \$4.00 per copy, \$1.45 microfiche. Report No 293, July 1973. 17 p, 5 fig, 9 tab, 4 ref.

Descriptors: Environment, \*Radioactivity, Measurement, \*Assay, \*Monitoring, \*Fallout, \*Cesium, \*Strontium, Precipitation(Atmospheric), Oceans, Vegetation, Animal population, Potable water, Human population, Diets.  
Identifiers: \*Greenland.

Measurements of fallout radioactivity in Greenland in 1972 are reported. Strontium-90 (and Caesium-137 in most instances) was determined in samples of precipitation, sea water, vegetation, animals, and drinking water. Estimates of the mean contents of Sr-90 and Cs-137 in the human diet in Greenland in 1972 are given. (Houser-ORNL)  
W74-09088

**ARTIFICIAL RECHARGE-STATE OF THE ART**, Geological Survey, Lubbock, Tex.  
For primary bibliographic entry see Field 4B.  
W74-09091

**A BACTERIAL METHYLMERCURY-MINERALIZING ACTIVITY IN RIVER SEDIMENTS**, Brussels Univ. (Belgium). Laboratorium voor Ekologie en Systematiek.  
G. Billen, C. Joiris, and R. Wollast.  
Water Research, Vol 8, No 4, p 219-225, April 1974. 4 tab, 16 ref.

Descriptors: \*Mercury, \*Bottom sediments, Biodegradation, Biochemistry, Heavy metals, Path of pollutants, Bacteria, Ecology.  
Identifiers: \*Methyl mercury, \*Belgium(Sambre River).

Bacterial activity involving mineralization of methylmercury was found in bottom sediments of the Sambre River (Belgium), in a zone highly polluted with inorganic mercury. The possibility that biological production of toxic methylmercury compounds occurs in such a medium gives a great ecological significance to this finding. The mineralizing capacity of the community can be increased in response to increased concentrations of methylmercury, probably by means of the selection of methylmercury-resistant bacterial species. Because of this adaptation, it is suggested that some equilibrium can be reached between the degradation of methylmercury and its addition to, or its production in, mineral mercury-polluted environments. (Knapp-USGS)  
W74-09092

**A SIMPLE SIMULATION METHOD FOR RIVER SELF-PURIFICATION STUDIES**, Centre Belge d'Etude et de Documentation des Eaux, Liege.  
F. Edeline, and G. Lambert.  
Water Research, Vol 8, No 5, p 297-306, May 1974. 10 fig, 28 ref.

Descriptors: \*Self-purification, \*Oxygen demand, \*Oxygen sag, Nitrification, Mathematical models, Equations, Mixing, Reaeration, Dissolved oxygen, \*Simulation analysis.

A simple simulation system is described for the study of river self-purification processes. A linear relationship between the organic load and the critical deficit on the sag curve was obtained for each temperature, corresponding to 36%-52% assimilation. The rate is not constant, and the monomolecular theory is not suitable to describe the results. Two distinct phases are observed. Nitrification appears as a second and distinct sag in the oxygen curve. It is limited by oxygen transfer and equilibrates at an O<sub>2</sub> tension of 0.6-1.05 mg per liter. (Knapp-USGS)  
W74-09093

**DEPOSITION OF DDE AND POLYCHLORINATED BIPHENYLS IN DATED SEDIMENTS OF THE SANTA BARBARA BASIN**, California Univ., Bodega Bay. Bodega Marine Lab.  
W. Hom, R. W. Risebrough, A. Soutar, and D. R. Young.  
Science, Vol 184, No 4142, p 1197-1199, June 14, 1974. 1 fig, 1 tab, 15 ref. NSF Grant GX-32885, NFS Grant GA-27306.

Descriptors: \*Polychlorinated biphenyls, \*DDE, \*Bottom sediments, \*California, \*Path of pollutants, Radioactive dating, Sedimentation.  
Identifiers: \*Santa Barbara Basin(Calif).

In the Santa Barbara Basin of the Southern California Bight, deposition of polychlorinated biphenyls (PCB) began about 1945 and DDE first appeared about 1952. Concentrations of both show a progressive increase through 1967; estimated deposition rates (in grams per square meter per year) in 1967 of DDE and PCB were 0.00019 and 0.00012, respectively. (Knapp-USGS)  
W74-09097

**ACID RAIN: A SERIOUS REGIONAL ENVIRONMENTAL PROBLEM**, Cornell Univ., Ithaca, N.Y. Section of Ecology and Systematics.  
G. E. Likens, and F. H. Bormann.  
Science, Vol 184, No 4142, p 1176-1179, June 14, 1974. 2 fig, 32 ref.

Descriptors: \*Path of pollutants, \*Precipitation(Atmospheric), \*Acids, \*Air pollution, Water pollution sources, Industrial wastes, Sulfates, Nitrates, Chlorides.  
Identifiers: \*Acid rain.

Acid rain and snow are falling on most of the northeastern United States. The annual acidity value averages about pH 4, but values between pH 2.1 and 5 have been recorded for individual storms. The acidity of precipitation in this region apparently increased about 20 years ago, and the increase may have been associated with the augmented use of natural gas and with the installation of particle-removal devices in tall smokestacks. (Knapp-USGS)  
W74-09098

**WATER QUALITY MODELS USING THE BOX-JENKINS METHOD**, Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.  
P. M. Huck, and G. J. Farquhar.  
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 100, No EE3, Paper 10629, p 733-752, June 1974. 9 fig, 7 tab, 13 ref, append.

Descriptors: \*Time series analysis, \*Path of pollutants, Water quality, \*Statistical models, Water pollution, Chlorides, Dissolved oxygen, Model studies, Time series analysis.

Identifiers: \*Box-Jenkins method.

The Box-Jenkins method, a time-based technique for time series analysis, is successful in modeling chloride and dissolved oxygen data for the St. Clair River near Corunna, Ontario. The technique is superior in the situation to either a frequency-based approach or a deterministic causative model. The model building process includes identification, estimation, and diagnostic checking stage. Forecasting and interpretation follow the derivation of successful models. An autoregressive type of model best represents the chloride data, and a moving average process represents the dissolved oxygen. Similar causative mechanisms appear to influence June and December chloride and June dissolved oxygen. (Knapp-USGS)  
W74-09113

**STOCHASTIC MODEL OF DYNAMIC EUTROPHIC ESTUARY**, Virginia Polytechnic Inst. and State Univ., Blacksburg.  
W. R. Schofield, and R. G. Krutchkoff.  
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 100, No EE3, Paper 10578, p 613-628, June 1974. 1 fig, 2 tab, 23 ref, append.

Descriptors: \*Estuaries, \*Eutrophication, \*Statistical models, \*Path of pollutants, \*Mathematical models, Stochastic processes, Water pollution, Potomac River, Model studies.  
Identifiers: \*Potomac estuary.

A stochastic model for a one-dimensional estuary was formulated. With the addition of a single new parameter, a stochastic model can be built from its deterministic counterpart. The derivation is sufficiently general to permit any number of components and any reasonable system configuration to be handled. All system parameters, conditions, and forcing functions could be continuous functions of time (not just tidal phase), position, and other factors. The Potomac estuary was modeled for the period January to October, 1969. Measured and predicted concentrations were compared in their means and in the distributions with good agreement. (Knapp-USGS)  
W74-09114

**THE TIDE OF INDUSTRIAL WASTE**, J. McCaull.  
Environment, Vol 14, No 10, p 31-39, December 1972. 3 photo, 3 tab, 21 ref.

Descriptors: \*Water pollution control, Contamination(Water), Pollution(Stream), Biochemical oxygen demand, Chemical wastes, \*Industrial wastes, Wastes, \*Water pollution sources, \*Environmental effects, Waste treatment.

With the rise in industrial expansion, the country's streams and rivers are rapidly becoming more contaminated. Over a third of all pollution in United States streams is due to industry. Despite recycling and water purification programs, the net effect is still a further decline in water quality. Many segments of industry are turning to new materials or techniques to speed production at the cost of increased environmental degradation. The economy of the U.S. has been marked not only by a voracious absolute demand for more goods, but by a relative preference for goods whose production involves a substantial wasting of organic materials and water. In the immediate future there will be increased environmental pollution caused by organic chemical contamination. The major factor in this trend is the versatility of modern industrial chemistry, which is based on petroleum as a raw material. The costs of continued pollution must be weighed against the benefits of the technology causing it. Such an analysis must be applied to the decision process when considering the introduction of new technology, alternation of the old, and selection of alternatives if there is to

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be a true balance between industrial and environmental demands. (Daniels-Florida)  
W74-09119

**DO NUCLEAR PLANTS MAKE DEADLY NEIGHBORS.**  
Washington Univ., St. Louis, Mo. Center for the Biology of Natural Systems.  
For primary bibliographic entry see Field 5G.  
W74-09123

**PARTIAL AREA HYDROLOGY AND ITS APPLICATION TO WATER RESOURCES.**  
Agricultural Research Service, University Park, Pa. Northeast Watershed Research Center.  
For primary bibliographic entry see Field 2A.  
W74-09200

**CYCLING AND CONTROL OF METALS.**  
Available from NTIS, Springfield, Va 22151, as PB-216 184, price \$6.00 printed copy; \$1.45 microfiche. Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, February 1973. 187 p.

Descriptors: \*Path of pollutants, \*Trace elements, \*Heavy metals, Lead, Zinc, Copper, Mercury, Iron, Asbestos, Beryllium, Industrial wastes, Mine wastes, Water pollution control, Monitoring. Identifiers: Arsenic.

The problems of metals and their relationships to the environment were discussed in a conference held in 1973. The source of trace metals in the environment, their transport and effects, control processes, monitoring, and economic and legal aspects are among the topics discussed. (See W74-09207 thru W74-09217) (Knapp-USGS)  
W74-09206

**NATURAL SOURCES OF SOME TRACE ELEMENTS IN THE ENVIRONMENT.**  
Geological Survey, Washington, D.C.  
M. Fleischer.

In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus Ohio: Environmental Protection Agency National Environmental Research Center, p 3-10, February 1973. 1 fig, 9 tab, 42 ref.

Descriptors: \*Lead, \*Cadmium, \*Arsenic compounds, \*Mercury, Water pollution sources, Industrial wastes, Weathering, \*Trace elements, \*Path of pollutants.

Natural sources of lead, cadmium, arsenic, and mercury in the environment are discussed. Particular attention is directed towards concentrations of these elements in natural materials whose present uses (coal, phosphorite, sedimentary iron ores) or possible future uses (oil shale) could cause environmental problems. More than 90% of the lead and cadmium discharged into the atmosphere and streams can be ascribed to manmade sources. The natural sources of arsenic, particularly the erosion of surface rocks, may account for a significant portion of its discharge to the atmosphere and streams. The very large amount of material involved, especially the emanations from mud volcanoes, indicates the proportion of mercury reaching the atmosphere and waters from natural sources must be high; possibly of the order of 30% to 70% of the total. Sediments of southeastern Lake Ontario show a spectacular increase of mercury from 1906 to the 1940's. In this industrialized area, man's activities supply about two-thirds of the mercury. (See also W74-09206) (Knapp-USGS)  
W74-09207

**THE LEAD INDUSTRY AS A SOURCE OF TRACE METALS IN THE ENVIRONMENT.**  
Missouri Univ., Rolla.  
B. G. Wixson, E. Bolter, N. L. Gale, J. C. Jennett, and K. Purushothaman.  
In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 11-19, February 1973. 7 fig, 16 ref.

Descriptors: \*Water pollution sources, \*Mining, \*Lead, \*Missouri, \*Mine water, Mine drainage, Mine wastes, Spoil banks, Air pollution, Streams, Trace elements, Heavy metals, Industrial wastes. Identifiers: \*New Lead Belt(Mo).

In order to evaluate the effects of the developing lead mines in southeastern Missouri on water quality and aquatic ecosystems, an extensive sampling program was established. Twenty-one principal sampling sites were selected. Samples were analyzed for both heavy metals and organic parameters of pollution. Heavy metal concentrations in the streams, before the start of the mining activity and in the control streams following the start of the activity, were in the range of 1 to 20 parts per billion (ppb) for copper, lead, and zinc. Most of the values were in the 4 to 6 ppb range and the water pH ranged from 7.0 to 8.8. The results of lead analyses on selected stream sites, over a 1-year period, showed 22 separate unfiltered samples which were in excess of the 0.05 ppm limit set for drinking water. High values were invariably concomitant with storm runoff. Problems with zinc in effluents occur in two mining and milling effluent discharges. The heavy metal content of mine and mill discharge waters, in the New Lead Belt of Southeastern Missouri, could be sufficiently reduced in retention lagoons to permit discharge into streams. Transport of ore concentrate in open trucks or railroad cars, without coverage, contributes windblown trace metals into the environment. The air pollution problems created by smelting the sulfide-containing concentrates include sulfur dioxide derived from sinter machines, as well as dusts, and fumes containing lead and other heavy metals from the sintering operation. (See also W74-09206) (Knapp-USGS)  
W74-09208

**SOURCES OF TRACE METALS FROM HIGHLY-URBANIZED SOUTHERN CALIFORNIA TO THE ADJACENT MARINE ECOSYSTEM.**

Southern California Coastal Water Research Project, Los Angeles.  
D. R. Young, C. S. Young, and G. E. Hlavka.  
In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 21-39, February 1973. 7 fig, 15 tab, 9 ref.

Descriptors: \*Path of pollutants, \*Water pollution sources, \*Trace elements, \*California, \*Sea water, Coasts, Advection, Ocean currents, Lead, Cadmium, Iron, Zinc, Mercury, Copper, Nickel, Manganese, Chromium, Urban runoff, \*Municipal wastes.

Approximately 1000 mgd of treated municipal wastewaters are discharged daily through marine outfalls to the Southern California Bight. Most of this, 84%, receives primary treatment only. Trace metals monitoring programs by the major dischargers were established prior to, or during, 1971. This has enabled a reliable estimate of trace metal mass emission rates from municipal wastewater discharges to the Bight of 1971. Of the estimated input routes of locally derived copper and mercury, municipal wastewater discharge, vessel antifouling paint, and direct rainfall all appear to have about the same importance. For zinc, municipal wastewater and direct rainfall appear to

predominate. In the case of lead, the surface runoff input is the same order as that of municipal wastewaters, but these sources probably contribute an order of magnitude less lead to the waters of the Bight than does aerial fallout. Cobalt, iron, and manganese are the only other trace metals studied that have surface runoff inputs of approximately the same importance as those of municipal wastewaters, and the inputs of these metals via both modes may be more dependent on natural than anthropogenic sources. However, for silver, cadmium, chromium, and nickel, present data suggest that municipal wastewater discharge to the Bight dominate all other locally-derived inputs. With the exception of chromium, lead, and iron, for each of the trace metals studied the sum of all estimated yearly inputs emanating from the coastal plain of the Bight is one to two orders of magnitude below the estimated annual flux of the metal through the Bight via ocean current advection. (See also W74-09206) (Knapp-USGS)  
W74-09209

**PHYSICAL TRANSPORT OF TRACE METALS IN THE LAKE WASHINGTON WATERSHED.**

Washington Univ., Seattle.  
R. S. Barnes, and W. R. Schell.  
In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 45-53, February 1973. 6 fig, 5 tab, 28 ref. EPA Grant No R-800357.

Descriptors: \*Trace elements, \*Path of pollutants, \*Washington, Lakes, Lead, Mercury, Copper, Zinc, Sodium, Iron, Air pollution, Industrial wastes, Municipal wastes. Identifiers: \*Lake Washington(Wash).

In the drainage basin of Lake Washington, trace metal enrichment is correlated with the cultural development of the region. The trace elements are brought into the local hydrosphere principally by advective atmospheric transport. Fluvial processes are of considerable significance, but appear to be reflected in the sediments primarily on the basis of the suspended load. Trace metal analysis of recent lake sediments can provide meaningful data concerning the impact of man on his environment, and offers a unique opportunity for evaluating past environmental conditions. Based on the lake volume, fluvial output and sedimentary deposition, the following mean residence times were estimated: iron, 11 days; lead, 26 days; mercury, 15 months; copper, 16 months; zinc, 21 months; and sodium, 29 months. The mean residence time for the lake water is also 29 months. (See also W74-09206) (Knapp-USGS)  
W74-09210

**BIOLOGICAL UPTAKE AND DISTRIBUTION OF LEAD IN ANIMALS.**

Illinois Univ., Urbana.  
For primary bibliographic entry see Field 5C.  
W74-09211

**TRACE METALS IN EFFLUENTS FROM METALLURGICAL OPERATIONS.**

Battelle Columbus Lab., Ohio.  
For primary bibliographic entry see Field 5D.  
W74-09212

**POLLUTION ABATEMENT IN THE METAL FINISHING INDUSTRY.**

Environmental Protection Agency, Edison, N.J.  
For primary bibliographic entry see Field 5D.  
W74-09213

**CONTROL AND PREVENTION OF MINE DRAINAGE.**

Environmental Protection Agency, Cincinnati, Ohio.  
For primary bibliographic entry see Field 5D.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

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W74-09214

#### MONITORING FOR TRACE METALS—WATER ENVIRONMENT,

National Environmental Research Center, Cincinnati, Ohio.

For primary bibliographic entry see Field 5A.  
W74-09215

#### MONITORING OF SOLID WASTES,

Michigan Univ., Ann Arbor.

For primary bibliographic entry see Field 5A.  
W74-09216

#### DIMENSIONS OF MONITORING,

MITRE Corp., McLean, Va.

For primary bibliographic entry see Field 7A.  
W74-09217

#### EFFECT OF MINE DRAINAGE ON THE QUALITY OF STREAMS IN COLORADO, 1971-72,

Geological Survey, Lakewood, Colo.

D. A. Wentz.

Colorado Water Resources Circular No 21, 1974. 117 p, 9 fig, 3 plate, 12 tab, 93 ref, append.

Descriptors: \*Acid mine water, \*Mining, \*Colorado, \*Trace elements, Mine acids, \*Iron, Heavy metals, Water temperature, \*Sulfates, Copper, Zinc, Water pollution sources, Water pollution effects, Water quality, \*Mine drainage.

Mine drainage in Colorado is commonly acid water containing high concentrations of iron and sulfate. The oxidation of metal sulfides under acid conditions releases high concentrations of trace elements to the water. Field observations of temperature, specific conductance, pH, stream-bottom conditions, and aquatic biota at 995 stream sites in Colorado during 1971-72 were used as a guide in collecting 192 samples for analysis of sulfate and dissolved trace elements. Approximately 450 miles of streams in 25 different areas are adversely affected by metal-mine drainage. Of the trace elements for which the U.S. Public Health Service has established drinking water standards, cadmium exceeds its limit in more than 12% of the samples, while arsenic and lead exceed their limits in 1-3% of the samples. Mercury and silver standards are not surpassed; chromium was not detected. Copper and zinc appear to present the greatest danger insofar as toxicity to resident aquatic life is concerned. Acid production is less of a problem in Colorado streams draining metal-mining areas than in streams draining the coal-mining areas of Appalachia. (Knapp-USGS)  
W74-09228

#### PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1973 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH - PART 2, ECOLOGICAL SCIENCES,

Battelle-Pacific Northwest Lab., Richland, Wash.

Environmental and Life Sciences Div.  
For primary bibliographic entry see Field 5C.  
W74-09233

#### ENVIRONMENTAL CHEMISTRY,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

R. E. Wildung, T. R. Garland, H. Drucker, R. C. Routson, and B. Klepper.

Int. Report No. BNWL-1850, Pt. 2, p 19-56, January 1974. 10 fig, 18 tab, 29 ref.

Descriptors: \*Environment, \*Chemistry, \*Plutonium, Soils, \*Absorption, \*Chemical reactions, Plants, \*Aquatic soils, Sediments, Marine plants, Marine animals, Radioactive waste disposal, Movement, Leaching, Radioecology, Ecosystems, Iodine, Suspended solids.

Reports studies of the potential for plutonium complexation in soil and uptake by plants, characteristics of Hanford soils and aquatic sediments, fate and effect of oil on marine coastal ecosystems, radioecology of iodine-129, and suspended particle interaction. The possibility exists that the chemical form of plutonium may be directly altered by the soil microflora, thereby increasing plutonium solubility in soil and uptake by plants. The fate of radionuclides in a broad range of surface soils is being studied. Suspended matter and sediments of the lower Columbia River Watershed is of current concern. The fate and effects of oil on marine coastal ecosystems are reported. Emphasis is given to the behavior of transuranium elements in soil-plant systems. Studies of iodine-129 include theoretical dose calculations, field studies of I-129 in the environment, and laboratory studies of iodine movement in soils and plants. Consideration is given to the environmental mobility of plutonium with respect to plant canopies to determine transfer coefficients. (See also W74-09233) (Houser-ORNL)  
W74-09235

#### FRESHWATER ECOLOGY,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

For primary bibliographic entry see Field 5C.  
W74-09236

#### MARINE SCIENCES,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

For primary bibliographic entry see Field 5C.  
W74-09237

#### RADIOLOGICAL SCIENCES,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

For primary bibliographic entry see Field 5C.  
W74-09238

#### TERRESTRIAL ECOLOGY,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

For primary bibliographic entry see Field 5C.  
W74-09239

## 5C. Effects Of Pollution

#### THE RECOVERY OF STREAM MACROBENTHIC COMMUNITIES FROM THE EFFECTS OF ACID MINE DRAINAGE,

Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Biology.

E. E. Herricks.

Available from the National Technical Information Service as PB-232 836; \$18.50 in paper copy, \$1.45 in microfiche. Ph D Dissertation June 1973. 279 p, 17 fig, 17 tab, 81 ref, 5 append. OWRR B-034-VA(4).

Descriptors: \*Mine acids, \*Mine drainage, \*Water quality, Tributaries, Neutralization, \*Pennsylvania, Water pollution control. Identifiers: \*Stream recovery, Macrobenthic communities, Recolonization, Indian Creek(Penn), Little Scrubgrass Creek(Penn).

The effects of short term low pH and long term acid mine drainage (AMD) stress were studied in relation to recovery and restoration of aquatic macrobenthic communities. Experimental acid additions were made to a healthy productive stream. Recovery was related to downstream drift of recolonizing organisms. A second study was made to observe drift born recolonizing organisms. Baetis sp. dominated drift collections and was most abundant in bottom fauna collections indicating a relationship between drift and section recovery. A two-year study was made on Indian

Creek, Fayette Co., Pa. which received a major and several minor AMD discharges. Recovery was shown by density and diversity values similar to upstream reference stations. The addition of unpolluted tributary waters provided suitable habitat for recolonizing organisms and recovery occurred within 10 miles of the initial AMD discharges. Hydrologic and water quality models were also applied and developed. Estimated periods of high stream discharge correlated well with periods of high stream density and diversity in stream biota. Another study was made on Little Scrubgrass, Venango Co., Pa. to observe the effect of lime neutralization on the recovery process. Within 8 miles, water quality was restored downstream. Hydroxide floc, a by-product of AMD neutralization created a secondary stress at times.  
W74-08701

#### PHOTOSYNTHESIS IN CELL DEVELOPMENT,

Maryland Univ., College Park. Dept. of Botany. C. Sorokin.

Biochim. Biophys. Acta, Vol 94, No 1, p 42-52, 1965. (Illus).

Descriptors: \*Algae, \*Artificial media, \*Testing, \*Photosynthesis, \*Cytological studies, Chlorophyta, \*Chlorella, Metabolism, Water pollution effects.

Nonsynchronized suspensions of the green, high-temperature alga Chlorella 7-11-05 were subjected to fractional centrifugation, and two size groups of cells were separated. The small-cell fraction was presumed to consist largely of younger cells and the large-cell fraction predominantly of older cells. Manometric measurements in phosphate buffer at pH 4.5, in bicarbonate buffer at neutral pH, and in carbonate-bicarbonate buffer at pH 9.3 indicated that younger cells invariably possessed higher photosynthetic activity than older cells, provided the separation of cells into size fractions was reasonably good and the large cells were prevented from dividing during the process of separation. The superior activity of younger cells was ascertained at various light intensities and at different temperatures. Previous observations on the decline in photosynthetic activity with the age of synchronized cells were thus substantiated in the absence of a synchronizing agent, and the decline in photosynthetic capacity must be assumed to be characteristic of normal cell development. The decline in metabolic activity in the course of cell development is discussed in connection with metabolic turnover and is viewed as a demonstration of aging of cells.  
W74-08713

#### USE OF DAPHNIA MAGNA FOR THE MICROBIO-ASSAY OF PESTICIDES. I. DEVELOPMENT OF STANDARDIZED TECHNIQUES FOR REARING DAPHNIA AND PREPARATION OF DOSAGE MORTALITY CURVES FOR PESTICIDES,

For primary bibliographic entry see Field 5A.  
W74-08714

#### USE OF DAPHNIA MAGNA FOR THE MICROBIO-ASSAY OF PESTICIDES. II. COMPARISON OF MICROBIO-ASSAY WITH GAS CHROMATOGRAPHY FOR ANALYSIS OF PESTICIDE RESIDUES IN PLANT EXTRACTS,

For primary bibliographic entry see Field 5A.  
W74-08715

#### ACCUMULATION OF DDT BY AQUATIC INDICATOR ORGANISMS,

Utah Univ., Ogden.

R. F. Gaufin.

Thesis, 1967. 230 p.

Descriptors: Degradation, \*DDT, \*Toxicity, \*DDE, Water pollution effects, \*Bioindicators, \*Absorption, \*Biomass. Identifiers: Accumulation.

In laboratory and field studies on the accumulation of DDT by aquatic organisms, using both organisms with extensive previous exposure to DDT and those with no previous contact, the accumulation of DDT was related to the concentration of DDT in the water and increased with increases in concentration, in temperature, and in the solubility of the formulation used. The relative amounts of DDT accumulated tended to decrease with increase in biomass, and the rate of accumulation was affected by the composition of the biomass. The rates and mechanisms of accumulation for various species were related less to phylogenetic relations than to the degree of previous exposure of the population to DDT; samples from populations with a previous history of exposure could tolerate higher concentrations in the experiments and were more effective in accumulating, eliminating, and degrading DDT. Age and sex also had different effects on accumulation of DDT, which differed for different species. The method of uptake affected the residues found in the body; accumulation through the digestive system resulted in accumulation of large amounts of DDE, while accumulation through the exo-skeleton resulted in larger proportions of p,p'-DDT and o,p'-DDT. In view of the complex factors affecting the accumulation of DDT by aquatic organisms it is considered that no convenient scheme could be developed for the use of these organisms as indicators of pesticide contamination of surface waters.

W74-08716

#### RESPIRATION AND OSMOTIC BEHAVIOUR OF THE COPEPOD ACARTIA TONSA IN DILUTED SEA WATER.

Hull Univ. Dept. of Zoology. (England).

J. Lance.

Comparative Biochemical Physiology, Vol 14, No 1, p 155-165, 1965. (Illus.).

Descriptors: \*Physiology, \*Salt tolerance, \*Copepods, \*Respiration, Plankton, \*Osmotic pressure, Oxygen requirements, Water pollution effects.

Identifiers: \*Acartia tonsa.

Adult females of the euryhaline planktonic copepod *Acartia tonsa* show increased oxygen requirements when the salinity of the surrounding sea water is lowered. The rise in respiration occurring during an 8-hr period of exposure to the diluted medium ranges from 0.077 ul oxygen/mg dry weight/hr at 90‰ sea water (0.7% increase) to 16.061 ul oxygen/mg/hr at the lowest salinity 30‰ sea water (101.4% increase). The increased metabolic rate can persist in diluted sea water for more than 24 hr. The internal osmotic concentration of copepods transferred from full-strength sea water to 50‰ sea water falls rapidly due to entry of water into the body. After 1 hr no further osmotic change can be detected.

W74-08717

#### THE EFFECT OF TEMPERATURE ON THE GROWTH AND SURVIVAL OF SEVEN MARINE ALGAL SPECIES.

Fish and Wildlife Service, Milford, Conn.

R. Ukeles.

Biological Bulletin, Vol 120, No 2, p 255-264, 1961.

Descriptors: \*Algae, Temperature, \*Cultures, \*Thermal pollution, \*Marine algae, Phytoplankton, Water pollution effects, Growth, Inhibition, Chlorella.

Identifiers: \*Algal growth.

The effect of temperatures ranging from 8 deg C to 39 deg C on the growth of 17 species of marine phytoplankton has been investigated. Growth of all organisms tested took place between 18 deg and 22 deg C. There was no growth of the following organisms above 30 deg C: *Monochrysis lutheri*, *Isochrysis galbana*, *Phaeodactylum tricornutum*, *Chlamydomonas* sp., *Chlorella* sp. (UHCM), *Protococcus* sp. (T3), *Nitzschia laevis*, and

*Melosira* sp. Multiplication at 30 deg C occurred in *Dunaliella euchlora*, *Chlorella* sp. (580), *Chlorococcum* sp., *Platymona* sp., *Protococcus* sp. (T9), *Amphiprora* sp., *Actinocyclus* sp. and *Amphora* sp. Survival at elevated temperatures is often dependent upon the time of exposure. The absence of growth at an elevated temperature may be due either to an inhibition that is reversible or to an irreversible heat death. At 8 deg C the rate of growth may be reduced or inhibited, but in no case was this low temperature lethal.

W74-08718

#### PHOSPHORUS CONTENT AND RATE OF GROWTH IN THE DIATOMS CYCLOTELLA NANA AND THALASSIOSIRA FLUVIATILIS.

New York State Dept. of Health, Albany. Div. of

Labs. and Research.

G. W. Fuhs.

Journal of Phycology, Vol 5, No 4, p 312-321,

1969. (Illus.).

Descriptors: \*Algae, \*Growth rates, \*Chemostat, \*Phosphorus, \*Diatoms, Water pollution effects.

Identifiers: Turbidostat, \*Cyclotella nana,

\*Thalassiosira fluviatilis.

*Cyclotella nana* and *T. fluviatilis* were grown in chemostat and turbidostat units in 1/3 strength artificial seawater supplemented with nutrients and vitamin B12 in excess except for P which in concentrations of 50 or 100 ug/liter was limiting. Different chemostat and turbidostat settings produced different cell numbers per unit volume which, since external P was practically nil, corresponded to varying amounts of bound P per cell. Growth rate plotted vs. P per cell follows a saturation curve. While no growth occurs at a certain minimum content of bound P, half the maximum growth rate is observed at twice the minimum level of P, 3/4 of the maximum at 3 times the minimum level, etc., the maximum growth rate being defined as that observed during growth unrestricted by P supply at a given set of conditions (light, temperature, salinity, etc.). Temperature and light were varied from 13.5 to 24 deg C and from 2000 to 6000 lux (continuous and intermittent). An abnormal growth curve was found with *C. nana* at 24 deg C and 6000 lux continuous light. Any change in P content of the cells significantly alters cell composition as reflected in P distribution in acid-soluble, lipid, and acid-insoluble fractions and in organic C content. External P does not immediately enter the equation for growth rate but is one of the factors determining rate of P uptake and therefore bound P per cell. Conditions governing uptake, however, cannot be adequately controlled in a chemostat and therefore should be determined in a different experimental approach. (See also W72-02718)

W74-08719

#### INFESTATION OF THE COPEPOD ACARTIA TONSA WITH THE STALKED CILIATE ZOOTHAMNIUM.

Lehigh Univ., Bethlehem, Pa. Dept. of Biology.

S. S. Herman.

Science, Vol 146 (3643), p 543-544, 1964. (Illus.).

Descriptors: Ecology, \*Symbiosis, \*Protozoa, \*Copepods, \*Maryland, Water pollution effects, Animal parasites.

Identifiers: \*Acartia tonsa, \*Patuxent River(Md), *Zoothamnium*, *Acartia clausi*.

An entire population of the copepod *Acartia tonsa* in the Patuxent River, Maryland, was infested with a stalked protozoan of the genus *Zoothamnium*. Each copepod had 25 to 200 ciliates attached around the appendages. The infestation occurred at the time when *Acartia tonsa* was being replaced as the dominant copepod by *Acartia clausi*.

W74-08720

#### ON THE REARING OF COPEPODS IN THE LABORATORY. (SUR L'ELEVAGE DE COPEPODES AU LABORATOIRE).

Centre National de la Recherche Scientifique, Gif-sur-Yvette (France).

L. de Lepiney.

Hydrobiologia Vol 20, No 3, p 217-222, 1962.

Descriptors: \*Copepods, Chlorella, Cultures, Water pollution effects.

Identifiers: \*Rearing techniques, \*Cyclops vicinus, Colpidium campylus, Paramecium caudatum.

The effects of rearing *Cyclops vicinus* in 5 different culture media are described. Using the best medium a further 7 spp. of copepod were reared and fed with *Chlorella pyrenoidosa*, *Colpidium campylus* or *Paramecium caudatum*.

W74-08721

#### SOME CHEMICAL CONSIDERATIONS IN THE DESIGN OF SYNTHETIC CULTURE MEDIA FOR MARINE ALGAE.

Marine Biological Station, Millport (Scotland).

M. R. Droop.

Bot Marine, Vol 2, Nos 3/4, p 231-246, 1961 (Illus.).

Descriptors: \*Algae, \*Cultures, Chelaton, Iron, Hydrogen ion concentration, Salinity, \*Metals, \*Oxidation-reduction potential, Water pollution effects.

Identifiers: \*Chelating agents, \*EDTA, Citric acid.

The mode of action of chelating agents is discussed with reference first to iron, Eh and pH, then to the influence of salinity and chelating agent on the general equilibrium in mixtures of metals. Citric acid has distinct advantages over EDTA in marine media. Control of redox potential and of pH is discussed.

W74-08722

#### AN ALGAL MASS CULTURE UNIT FOR FEEDING MARINE INVERTEBRATE LARVAE.

Commonwealth Scientific and Industrial Research Organization, Crenulla (Australia). Div. of Fisheries and Oceanography.

B. Wisely, and C. Purday.

Australia Commonwealth Scientific and Industrial Research Organization, Division Fish. and Oceanogr. Technical Paper 12, 2-12, 1961 (Illus.).

Descriptors: \*Algae, \*Cultures, \*Aseptic conditions, \*Temperature, \*Growth rates, Water pollution effects, Chrysophyta, Invertebrates.

Identifiers: *Isochrysis galbana*, *Dunaliella tertiolecta*, *Phaeodactylum tricornutum*, *Bacillariophyta*, *Flagellates*.

A unit is described which produces unialgal but not bacteria-free continuous or batch (400 l.) cultures. In three experiments at 19-20°C the flagellate *Isochrysis galbana* Parke (*Chrysophyceae*) reached maximum densities of 2.0, 0.8, and 2.2 x 10 to the 6th power cells/ml in 37, 39, and 30 days of culture respectively. In three experiments at 19-20°C the flagellate *Dunaliella tertiolecta* Butcher (*Chlorophyceae*) gave densities of 1.7, 1.9, and 2.2 x 10 to the 5th power cells/ml in 13, 63, and 27 days. In five experiments at various temperatures the diatom *Phaeodactylum tricornutum* Bohlin (*Bacillariophyceae*) gave densities of 1.5, 2.3, 3.2, 3.2, and 6.0 x 10 to the 6th power cells/ml in 21 (27°C), 11 (27°C), 22 (23°C), 22 (22°C), and 26 (17°C) days. In all experiments densities suitable for feeding larvae were obtained within 10 days.

W74-08723

#### SOME METHODOLOGICAL OBSERVATIONS ON THE USE OF ANTIBIOTICS FOR PREPARING BACTERIA-FREE ALGAL CULTURES.

Magyar Tudományos Akademia, Tihany. Biological Research Inst.

L. J. M. Felföldy, and Z. F. Kalko.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

Acta Biol Acad Sci Hungaricae, Vol 10, No 1, p 95-99, 1959.

Descriptors: \*Algae, \*Cultures, \*Antibiotics, \*Centrifugation, Water pollution effects, Bacteria. Identifiers: \*Aseptic condition, Organic agar media.

Bacteria-contaminated unialgal liquid cultures were passed through sterile medium by centrifugation and the centrifuged cells were allowed to stand in a sterile nutrient solution containing penicillin, streptomycin, aureomycin, and xanthracidine for 24 hours. Then the antibiotics were removed by repeated centrifugation and a large number of dilution cultures were made from each algal sample in Petri dishes containing peptone-yeast-glucose agar media. With this procedure, the ratio between algae and bacteria growing on the surface of the organic agar media was favorable.

W74-08724

**SURVIVAL OF SOME PELAGIC COPEPODS OF THE BLACK AND MEDITERRANEAN SEAS IN WATER OF DIFFERENT SALINITY, (VYZHIVANIE NEKOTORYKH PELAGICHESKIKH KOPEPOD CHERNOGO I VREDIZEMNOGO MOREI V VODE RAZLICHNOI SOLEOSTI),** Institute of Biology of the Southern Seas, Sevastopol (USSR). A. V. Kovalev.

Gidrobiol ZH, Vol 2, No 1, p 43-48, 1966 (Illus).

Descriptors: \*Salt tolerance, \*Copepods, Salinity, Water pollution effects. Identifiers: \*Acartia clausi, \*Survival rates, Black Sea, Mediterranean sea.

The results are presented of experiments on the survival of certain species of pelagic Copepoda in water of varying salinity. The species surviving over a wide range of salinity were chiefly those that are common for both the Black and Mediterranean seas. Of the Black Sea Copepoda the greatest changes in salinity were tolerated by the 'small' *Acartia clausi* which inhabits bay, sounds and the coast of the Black Sea where there are sharp fluctuations in the salinity of the water. The Black Sea Copepoda -- with the exception of the 'large' *A. clausi* tolerated an increase in salinity better than a decrease. They have, apparently, retained some part of their previous saline spectrum.

W74-08725

**EFFECTS OF COPEPOD GRAZING ON TWO NATURAL PHYTOPLANKTON POPULATIONS,** British Columbia Univ., Vancouver. Dept. of Zoology.

B. T. Hargrave, and G. H. Geen. Journal of Fishery Research Board of Canada, Vol 27, No 8, p 1395-1403, 1970 (Illus).

Descriptors: \*Grazing, \*Algae, \*Primary productivity, \*Copepods, \*Canada, Phytoplankton, Water pollution effects. Identifiers: \*Acartia, Nova Scotia (Cape Breton Island).

Feeding and filtration rates of 4 species of copepods (*Pseudocalanus minutus*, *Temora longicornis*, *Oithona similis*, and *Acartia tonsa*) from Bras d'Or Lake and Morrison's Pond, Cape Breton Island, Nova Scotia, were measured in the laboratory with natural populations of phytoplankton. Adult copepods ingested all sizes of flagellates (1-15  $\mu$  in maximum dimension) but 5-15  $\mu$  cells were removed most efficiently. Ceratium sp. and Chaetoceros sp., principal spring and winter forms, were not utilized. Feeding rate declined as the number of animals per liter and the duration of the experiment increased. Estimates of feeding rates in nature were derived by extrapolation from the results of laboratory experiments. A com-

parison of estimates of mean summer primary production at the depths of maximum photosynthesis and daily zooplankton food intake suggested that, at those depths, zooplankton in Bras d'Or Lake consumed all the average daily production whereas 66% was removed in Morrison's Pond. The remaining production in Morrison's Pond probably contributed to the support of large rotifer and ciliate populations not found in Bras d'Or Lake. Natural concentrations of flagellates were more than sufficient to meet copepod respiratory energy requirements under laboratory conditions.

W74-08726

**AN INVESTIGATION OF THE COULTER COUNTER IN 'BIOMASS' DETERMINATIONS OF NATURAL FRESHWATER PHYTOPLANKTON POPULATIONS,**

Royal Holloway Coll., Englefield Green (England).

For primary bibliographic entry see Field 5A.

W74-08727

**MARINE PHYTOPLANKTON VARY IN THEIR RESPONSE TO CHLORINATED HYDROCARBONS,**

Woods Hole Oceanographic Institution, Mass. D. W. Menzel, J. Anderson, and A. Randtke. Science, Vol 167, (3926), p 1724-1726, 1970 (Illus).

Descriptors: \*Algae, \*Toxicity, \*Chlorinated hydrocarbons, \*DDT, Phytoplankton, Water pollution effects, \*Photosynthesis, Endrin, Dieldrin, \*Growth rates.

Identifiers: *Skeletonema costatum*, *Cyclotella nana*, *Coccolithus huxleyi*, *Dunaliella tertiolecta*.

Photosynthesis and growth in cultures of 4 marine phytoplankton species (*Skeletonema costatum*, *Cyclotella nana*, *Coccolithus huxleyi*, *Dunaliella tertiolecta*), isolated from different oceanic environments, were affected by 3 chlorinated hydrocarbons (DDT, dieldrin, and endrin) to varying extents. This ranged from complete insensitivity in *Dunaliella* to toxicity at concentrations of 0.1 to 1.0 part per billion of the pesticides in *Cyclotella*. Other forms were intermediate in their response.

W74-08728

**MARINE PHYTOPLANKTON VARY IN THEIR RESPONSE TO CHLORINATED HYDROCARBONS,**

Woods Hole Oceanographic Institution, Mass. D. W. Menzel, J. Anderson, and A. Randtke. Science, Vol 167, p 1724-1726, March 1970, 1 fig, 9 refs. (Contribution No 2424 from Woods Hole Oceanographic Institute). NSF Grant GB 15103, AEC Contract AT(30-1)-3862.

Descriptors: \*DDT, \*Chlorinated hydrocarbon pesticides, \*Phytoplankton, Diatoms, Water pollution effects, Photosynthesis, Growth rates, Dieldrin, Endrin, Toxicity.

Identifiers: *Skeletonema costatum*, *Dunaliella tertiolecta*, *Coccolithus huxleyi*, *Cyclotella nana*.

Photosynthesis and growth in cultures of four marine phytoplankton species (*Skeletonema costatum*, *Dunaliella tertiolecta*, *Coccolithus huxleyi*, and *Cyclotella nana*) isolated from different oceanic environments, were affected by three chlorinated hydrocarbons (DDT, dieldrin, and endrin) to varying extents. This ranged from complete insensitivity in *Dunaliella* to toxicity at concentrations of 0.1 to 1.0 part per billion of the pesticides in *Cyclotella*. Other forms were intermediate in their response.

W74-08730

**RESPONSES OF GYMNOINIUM BREVE DAVIS TO NATURAL WATERS OF DIVERSE ORIGIN,**

Florida State Univ., Tallahassee. Dept. of Biological Science.

A. Collier, W. B. Wilson, and M. Borkowski. Journal of Phycology, Vol 5, No 2, p 168-172, 1969.

Descriptors: \*Algae, \*Productivity, Water types, \*Growth rates, Sulfides, Iron, Nitrogen, Phosphorus, Water pollution effects. Identifiers: \*Gymnodinium breve, EDTA.

The effect on the growth of *Gymnodinium breve* of river waters and seawater samples collected in different seasons and locations was investigated with and without differential enrichments. Growth in natural seawater was most clearly enhanced by addition of EDTA-Fe, sulfide, N and P. The seasonal variation in growth-promoting properties of seawater and river water dominates variations due to differences in location.

W74-08731

**LIGHT QUALITY AND CONCENTRATION OF PROTEINS, RNA, DNA AND PHOTOSYNTHETIC PIGMENTS IN TWO SPECIES OF MARINE PLANKTON ALGAE,**

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.

D. G. Wallen, and G. H. Geen. Marine Biology, Vol 10, p 44-51, 1971.

Descriptors: \*Marine algae, \*Light quality, Physiology, \*Chlorophyll, \*Protein, Photosynthesis, Phytoplankton, Pigments.

Identifiers: \*DNA, \*RNA, \*Cyclotella nana, \*Dunaliella tertiolecta.

Chlorophyll, protein, DNA and RNA concentrations in cultures of *Cyclotella nana* (Hustedt) and *Dunaliella tertiolecta* (Butcher) were higher in blue light and lower in green light than in white light of the same intensity. Total carotenoid concentrations were highest in green light. Total pigment concentrations were highest in cells grown in blue light, lowest in those from green light. The relative changes in pigment concentrations associated with differences in spectral composition of the radiation are comparable to those often observed in phytoplankton from various depths in stratified natural water. Light adaptation in algae as a response to light quality is suggested. The chemical composition of plankton algae can be expected to vary considerably with depth.

W74-08736

**LIGHT QUALITY IN RELATION TO GROWTH, PHOTOSYNTHETIC RATES AND CARBON METABOLISM IN TWO SPECIES OF MARINE PLANKTON ALGAE,**

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.

D. G. Wallen, and G. H. Geen. Marine Biology Vol 10, p 34-43, 1971.

Descriptors: \*Marine, Algae, \*Light quality, \*Productivity, \*Growth rates, Photosynthesis, Metabolism. Identifiers: \*Cyclotella nana, \*Dunaliella tertiolecta.

The effect of light quality on growth, photosynthesis and carbon metabolism in two species of marine algae, *Cyclotella nana* (Hustedt) and *Dunaliella tertiolecta* (Butcher), was examined. Relative growth constants for *C. nana* were 0.37, 0.29 and 0.25 in blue, white and green light, respectively. Corresponding constants were 0.41, 0.31, and 0.29 for *D. tertiolecta*. Photosynthetic rates in both species were higher in blue light and lower in green light compared with white light of the same intensity. More than 60% of  $^{14}\text{C}$  assimilated by *C. nana* or *D. tertiolecta* grown in blue or green light was incorporated into the ethanol-insoluble fraction

# WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

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compared with 10 to 30% in this fraction in white light. The relative importance of the various components within this fraction was independent of light quality. Although less  $^{14}\text{C}$  was assimilated into the ethanol-soluble fraction in blue or green light, there was a relative increase in some amino acids and organic acids in this fraction and a decrease in sugars and sugar phosphates relative to white light of the same intensity. These differences were independent of light intensity, photosynthetic rate and cell density in the cultures.

W74-08737

### THE SALINITY TOLERANCE OF SOME ESTUARINE PLANKTONIC COPEPODS, Hull Univ. (England). Dept. of Zoology.

J. Lance.  
Limnology and Oceanography, Vol 8, p 440-449, 1963.

Descriptors: Salinity, \*Copepods, \*Temperature, \*Salt tolerance, Estuarine environment, Water pollution effects.  
Identifiers: \*Acartia spp.

The salinity tolerance of three species of *Acartia* was investigated in the laboratory by recording the survival of female copepods at various salinities. The salinity tolerance of *A. tonsa*, *A. discoidata*, and *A. biflosa* captured during the autumn, winter, and spring, respectively, depended on the temperature. Thermal prehistory of copepods affected their survival in diluted seawater, all species being most tolerant when the experiment and environmental temperature were close and least tolerant when the experimental and field temperatures differed markedly. The following order of salinity tolerance was established: *A. tonsa*, *A. biflosa*, *A. discoidata*. Reinvestigation of the temperatures at which copepods had shown poorest survival in diluted seawater demonstrated that temperature acclimation increased salinity tolerance. The results imply that cooling of the environment might not necessarily lower the tolerance of the autumn, warmwater species, *A. tonsa*, provided that the change was gradual and that slow warming might not cause a decline in the tolerance of the spring, cold-water species, *A. biflosa*. Salinity acclimation increased the salinity tolerance of *A. biflosa*. The recovery of *A. biflosa* in full-strength seawater after short exposure to low salinities depended on the length of exposure.

W74-08738

### DECHLORINATION OF DDT BY AEROBACTER AEROGENES, Bureau of Sport Fisheries and Wildlife, Denver, Colo. Fish-Pesticide Research Lab. For primary bibliographic entry see Field 5B.

W74-08739

### A CONTINUOUS RECIRCULATING CULTURE SYSTEM FOR PLANKTONIC COPEPODS, National Marine Water Quality Lab., West Kingston, R.I.

E. J. Zillioux.  
Marine Biology, Vol 4, No 3, p 215-218, November 1969.

Descriptors: \*Plankton, \*Copepods, Cultures, \*Protozoa, Decomposing organic matter, Water pollution effects.  
Identifiers: \*Acartia spp., *Euplotes vannus*, *Isochrysis galbana*, *Rhodomonas baltica*, \*Flagellates.

The calanoid copepods, *Acartia clausi* Giesbrecht and *Acartia tonsa* Dana, are maintained at high densities in continuous culture at 15°C. Synthetic sea-water medium is recirculated through filters and a foam tower which limits accumulation of dissolved wastes and various metabolites. The ciliate *Euplotes vannus* Muller is associated in cul-

ture with the copepods, and effectively controls bacterial population and accumulation of algal debris. The copepods graze upon the ciliates as well as upon the phytoflagellates *Isochrysis galbana* Parke and *Rhodomonas baltica* Korsten.

W74-08740

### EXPERIMENTAL STUDY OF EGG-LAYING IN THREE NERITIC COPEPOD SPECIES (CENTROPAGES TYPICUS, ACARTIA CLAUSI, AND TEMORA STYLIFERA).

Centre d'Océanographie, Marseille (France). Station Marine d'Endoume.  
For primary bibliographic entry see Field 2L.

W74-08741

### GROWTH RATES OF MARINE PHYTOPLANKTON: CORRELATION WITH LIGHT ABSORPTION BY CELL CHLOROPHYLL A.

California Univ., San Diego, La Jolla. Inst. of Marine Resources.  
R. W. Eppley, and P. R. Sloan.  
Physiology Plant, Vol 19, No 1, p 47-59, 1966 (illus).

Descriptors: \*Growth rates, \*Photosynthesis, Pigments, Cytological studies, \*Chlorophyll, Phytoplankton, \*Marine algae.  
Identifiers: \*Dunaliella tertiolecta.

Cellular contents of photosynthetic pigments, cell volumes, cell surface areas and specific growth rate have been determined for batch cultures of 10 spp. of marine phytoplankton grown at a single constant light intensity and temperature. Similar data were obtained for *Dunaliella tertiolecta* at several light intensities and temperatures. The data were used to derive a model for predicting growth rate from a knowledge of temperature and light absorption by cell chlorophyll a. Growth rate was compared also with cell volume and surface area.

W74-08742

### INFLUENCE OF SOME ENVIRONMENTAL FACTORS ON PRODUCTIVITY OF PLANKTONIC ALGAE IN CULTURE. (ETUDE DE L'INFLUENCE DE QUELQUES FACTEURS DE MILIEU SUR LA PRODUCTIVITE D'UNE ALGUE PLANCTONIQUE EN CULTURE).

Aix-Marseille Univ., Marseille (France). Faculté des Sciences.  
S. Maestrini.  
Rec. Trav. Sta. Mar. Endoume, Vol 57, No 41, p 33-108, 1966 (illus.).

Descriptors: \*Algae, \*Cultures, \*Growth rate, \*Productivity, \*Photosynthesis, Pigments, Carbon dioxide, Plant physiology, Water pollution effects.  
Identifiers: Algal growth, Sulfactamide, Chloroamphenicol.

An elevation of light intensity from 1,000 to 7,200 lux is accompanied by more active growth and decreased pigment content in the *Phaedactylum tricornutum* cells. It is possible to eliminate the associated bacterial microflora with sulfactamide and chloroamphenicol, but this decreases algal growth. An atmosphere of air favors an increased rate of carbon assimilation, and an increase in the quantity of pigments produced. There is a decline in population density with increasing age of culture. This may be partly explained by the decrease in carbon dioxide concentration in the medium, but there may also be a change in the physiological state of the cells.

W74-08743

### EXTRACELLULAR CARBOHYDRATE LIBERATION IN THE FLAGELLATES ISOCHRYISIS GALBANA AND PRYMNESIMUM PARVUM.

Imperial Coll. of Science and Technology, London (England).  
A. F. H. Marker.

Journal of Marine Biology Association, United Kingdom, Vol 45, No 3, p 755-772, 1965.

Descriptors: \*Algae, Physiology, \*Growth rates, Testing, \*Carbohydrates, Cultures, Salinity, Nitrogen, \*Productivity, Cytological studies.  
Identifiers: Flagellates, \*Isochrysis galbana, \*Prymnesium parvum, Axenic cultures.

Extracellular carbohydrate liberation in *I. galbana* Parke and *P. parvum* N. Carter was studied in axenic culture in artificial sea water. Increased extracellular carbohydrate liberation occurred at both reduced and increased salinity and under conditions of N starvation in *Isochrysis*. Maximum production occurred during the early and later stages in growth falling to a minimum during the midgrowth phase. Greater extracellular carbohydrate production was found in *Prymnesium*. The cells did not appear to be damaged during harvesting. Hydrolysis of both extra- and intracellular carbohydrate yielded glucose, galactose, arabinose, xylose, and ribose. It is suggested that the presence of this extracellular carbohydrate is due to the passive release of organic matter from dead or dying cells.

W74-08745

### THE PRODUCTION OF EXTRACELLULAR CARBOHYDRATES BY SOME MARINE FLAGELLATES.

Yale Univ., New Haven, Conn. Osborn Zoological Lab.  
R. R. L. Guillard, and P. J. Wangersky.  
Limnology and Oceanography, Vol 3, No 4, p 449-454, October, 1958.

Descriptors: \*Algae, \*Carbohydrates, \*Productivity, Cytological studies, \*Cultures.  
Identifiers: \*Flagellates(Marine), *Isochrysis galbana*, *Monochrysis lutheri*, *Prymnesium parvum*.

Extracellular carbohydrate production during the growth of bacteria-free cultures of the marine flagellates *Isochrysis galbana*, *Monochrysis lutheri*, *Prymnesium parvum*, *Dunaliella euchlora*, *Pyraminomonas* sp., *Rhodomonas* sp., and *Chlamydomonas* sp. was followed by the N-ethyl carbazole method. Carbohydrate production did not parallel cell numbers during exponential growth of any of these organisms; maximum concentrations during this phase were under 3 mg/L. Carbohydrates accumulated in all stationary cultures (having 1 million - 10 million cells/ml), to the greatest extent in *Prymnesium* cultures, which attained 123 mg/L. *Isochrysis* and *Monochrysis* produced 25 and 16 mg/L, respectively, while the others had under 10 mg/L even when cell disintegration was evident.

W74-08746

### ECOSYSTEM OF THE SALTON SEA.

California State Univ., Long Beach. Dept. of Microbiology.  
For primary bibliographic entry see Field 4A.

W74-08752

### LIGHT AND TEMPERATURE RELATIONS IN A SMALL DESERT POND AS INFLUENCED BY PHYTOPLANKTONIC DENSITY VARIATIONS, Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

S. B. Idso, and J. M. Foster.  
Water Resources Research, Vol 10, No 1, p 129-132, February 1974. 5 fig, 8 ref.

Descriptors: \*Phytoplankton, \*Ponds, \*Light, \*Solar radiation, \*Density, Temperature, Algae, Regime, Waste water(Pollution), Seepage, Water sampling, Chlorophyll, Water pollution effects.  
Identifiers: Hygrothermograph, Thermocouples, Eppley pyrometer, Kipp solarimeter, Kemmerer-type water sampler bottle.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

A significant relationship was observed in a small desert man-made pond between phytoplankton concentrations and concurrent light and temperature regimes. Measurements of solar radiation, air, and water, temperature were recorded at 4 different depths every half hour over a 3-month period. Chlorophyll a and b values were measured every few days to determine density variations in the phytoplankton community. The depth of penetration of solar radiation was mainly controlled throughout the summer months by the concentration of phytoplankton. The degree of light penetration in turn controlled the severity of temperature stratifications within the pond. During periods of algal blooms, a sequential cooling of lower layers and a warming of the surface layers occurred. This rise in surface temperatures during algal blooms was calculated to be sufficient to increase the daytime water-air vapor pressure difference about 25 percent, indicating that evaporation may be influenced by planktonic density variations. (Mastic-Arizona)  
W74-08758

**PHOSPHORUS AND CARBON IN LAKE POLLUTION,**  
Basf-Wyandotte Chemical Corp., Mich.  
L. E. Kuentzel.  
Environmental Letters, Vol 2, No 2, p 101-120, 1971, 41 ref.

Descriptors: \*Algae, \*Phosphorus, \*Carbon, Carbon dioxide, \*Lakes, Alkalinity, Algae control, Growth rates, Organic matter, Organic wastes, \*Water pollution sources, Water pollution effects.

Recent laboratory and field tests and literature on the relationship between algae, phosphorus, and carbon in lake pollution are summarized. Algae can develop in waters containing only 10 ppb or less of phosphorus. Most natural waters have 10 ppb or more. Phosphorus is widespread in nature and widely used by man. Indications are that it will not be possible to reduce phosphorus to less than 10 ppm in urbanized areas by eliminating it from only detergents. It takes two pounds of carbon dioxide to grow one pound of algae. The amounts of carbon dioxide available from the atmosphere and the natural alkalinity of lake water are severely limited by physical and chemical laws. Algae growth depending solely on alkalinity and the atmosphere for carbon is relatively slow and limited by a rising pH at about 10. When adequate organic pollution is present, bacteria can undergo a massive population explosion, produce large amounts of carbon dioxide, and cause massive algae growths. The role of the organic matter becomes more evident in those cases where algae growth is massive in the presence of such pollution even though the phosphorus content of the water never exceeds 10 ppb. It appears that algae growth will be controlled only when organic pollution is controlled, regardless of the phosphorus content. (Merritt-FIRL)  
W74-08775

**OXYGEN UTILIZATION IN BACTERIAL-PROTOZOAN COMMUNITY,**  
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.  
R. P. Canale, and F. Y. Cheng.  
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 100, No EE1, p 171-185, February 1974, 10 fig, 1 tab, 14 ref.

Descriptors: \*Biochemical oxygen demand, Investigations, Recycling, Organic matter, Water quality, \*Protozoa, Nutrients, Cycling nutrients, Bacteria, \*Mathematical studies, \*Model studies, Metabolism, Water pollution effects.  
Identifiers: \*Aerobacter aerogenes, \*Tetrahymena pyriformis.

The dynamic relation between oxygen utilization, nutrient consumption, and bacterium and

protozoan growth in bath cultures was investigated with *A. aerogenes* and *T. pyriformis*. The results were interpreted with a mathematical model which incorporated the interactions of the bacterium and the protozoan as well as the effects of nutrient availability and oxygen utilization. The model has several unique aspects: nutrient recycling and refractory carbohydrate accumulation, protozoan bioenergetics, and protozoan cell size variability. The experimental and modeling results confirm the findings of Bhatla and Gaudy that the plateau observed in BOD tests is a slow bacterial respiration phase. It was shown that the second stage oxygen demand in heterotrophic bacterial protozoan communities is the result of protozoan metabolism. These findings should be useful for defining organic matter stabilization pathways in multicomponent ecological models and for water quality management. (Merritt-FIRL)  
W74-08776

**ASPECTS OF WATER POLLUTION IN FERTILISER INDUSTRY,**  
Central Public Health Engineering Research Inst., Nagpur (India).  
G. J. Mohanrao, and P. V. R. Subrahmanyam.  
Indian Journal of Environmental Health, Vol 15, No 4, p 271-282, October, 1973, 1 fig, 5 tab, 13 ref.

Descriptors: \*Fertilizers, \*Water pollution sources, Industries, Toxicity, Industrial water, Waste water(pollution), Water pollution control, Ammonia, Fluorides, Phosphates, Nitrogen compounds, Arsenic compounds.  
Identifiers: \*India.

There has been a continuous growth in the fertilizer industry in India in recent years to meet the ever increasing demand. The processes of manufacturing different types of nitrogenous and phosphatic fertilizers are described briefly. The volume and characteristics of the waste water discharged from the industry are indicated. The waste waters contain a variety of pollutants which include ammonia, fluorides, arsenic, phosphate, and urea. Water pollution potential of different units in the fertilizer industry is discussed. The need for better process control for reduction of water pollution is stressed. (Sandoski-FIRL)  
W74-08791

**CELL WALL PROPERTIES OF COTTON ROOTS AS INFLUENCED BY CALCIUM AND SALINITY,**  
Texas A and M Univ. Weslaco. Agricultural Research and Extension Center.  
For primary bibliographic entry see Field 3C.  
W74-08808

**COMPREHENSIVE MANAGEMENT OF PHOSPHORUS WATER POLLUTION,**  
Utah Water Research Lab., Logan.  
Copy Available from GPO Sup Doc as EPI.23-600/5-74-010, \$4.05; microfiche from NTIS as PB-232 958 \$1.45. Environmental Protection Agency, Socioeconomic Studies Series Report EPA-600/5-74-010, February 1974, 411 p, 47 fig, 43 tab, 82 ref. EPA Program Element 1BA030, Contract 68-01-0728.

Descriptors: \*Eutrophication, Nutrients, Primary productivity, \*Phosphorus, Trophic level, Agriculture, Industry, Recreation, Water quality, Economics, Lakes, Taxes, Detergents, Waste water treatment, Water pollution control, \*Lake Michigan, \*Lake Erie, \*Management.  
Identifiers: Cost effectiveness, Regional management, \*Mass flow model, Excise taxes.

The environmental problems of phosphorus pollution are examined using an activity analysis approach to account for phosphorus inputs to surface waters. For purposes of analysis, this study assumes phosphorus to be the limiting factor in algal growth and eutrophication. A mass flow

model, general enough to be applied to specific lakes or river basins, was developed in order to relate the flow of phosphorus from all activities in a basin to the consequences of eutrophication. Various control tactics to limit mass flow and thus eutrophication were defined from the standpoint of both supply and demand for phosphorus producing products and the management of phosphorus uses. Combinations of feasible controls designated as strategies, were applied to the model to determine the cost-effectiveness of the strategies in minimizing eutrophication. A hyper-eutrophic hypothetical lake basin, Lake Michigan, and Lake Erie were analyzed as case examples to test the model and control methods. Overall strategies were derived for the hypothetical lake and then applied to Erie and Michigan. In simple terms, phosphorus management strategies seemed feasible for control of eutrophication in present-day Lake Michigan while waste treatment together with management strategies was necessary for Lake Erie. (EPA)  
W74-08826

**THE DEVELOPMENT OF PHOSPHATE FREE HEAVY DUTY DETERGENTS,**  
Gillette Co. Research Inst., Rockville, Md.  
A. M. Schwartz, and S. E. Davis.  
Copy Available from GPO Sup Doc as EPI.23-600/2-74-003, \$2.65; microfiche from NTIS as PB-232 943, \$1.45. Environmental Protection Agency, Technology Series, Report EPA-600/2-74-003, March 1974, 234 p, 49 fig, 29 tab, 102 ref. EPA Project 16080 FWE, Contract 14-12-875.

Descriptors: Economic Analysis, \*Detergents, \*Surfactants, Toxicity, Domestic wastes, Water Quality, Reviews, \*Soaps, \*Biodegradation, \*Water Pollution effects.  
Identifiers: \*Phosphate-free detergents.

The purpose was to demonstrate state-of-the-art possibilities for producing phosphate-free household laundry detergents of satisfactory environmental and performance characteristics. The work involved formulation of several hundred experimental detergent compositions using different surfactant-builder combinations. These were tested for laundering performance, acceptability of physical form, biodegradability, aquatic toxicity, potential hazard in use, and growth stimulation of algae. Feasibility of economical production on an industrial scale was also considered. Some partially satisfactory formulations were found, and their shortcomings assessed with regard to performance and/or economic feasibility. These formulations coincide remarkably with formulations developed independently by industry. Further work with promising new builders and surfactant-builder combinations is recommended, but only along environmental and health hazard lines. (EPA)  
W74-08830

**EARLY LIFE HISTORY AND FEEDING OF YOUNG MOUNTAIN WHITEFISH,**  
Utah State Univ., Logan. Dept. of Wildlife Science.  
C. B. Stalnaker, and R. E. Gresswell.  
Copy Available from GPO Sup Doc as EPI.23-660/3-73-019, \$0.95; microfiche from NTIS as PB-232 992, \$1.45. Environmental Protection Agency, Ecological Research Series Report EPA-660/3-73-019, January 1974, 46 p, 18 fig, 13 tab, 11 ref. EPA Project 18050 DPL.

Descriptors: \*Life history studies, \*Spawning, \*Water temperature, Fish behavior, \*Fish food organisms, Fry, Aquatic habitats, Fish eggs, Thermal pollution, Mortality, Hatching, \*Utah, Water pollution effects.  
Identifiers: \*Mountain whitefish, \*Culture methods, Fish growth, \*Logan River(Utah).

Early life history studies and development of culture methods of the mountain whitefish

(*Prosopium williamsoni*) were conducted in the Logan River, and in the Utah State Research Laboratory and USU Fisheries Laboratory. Spawning was observed in the laboratory and in the Logan River from mid-November to mid-December during dusk. At ambient river temperature from 1.7-6.1 C eggs began hatching after 79 days and continued for 23 days. Total mortality to hatch of eggs from weekly collections from five areas was 92%. In the laboratory, at 7.2 C eggs began hatching in 52 days and continued for 23 days; at 8.9 C in 45 days and continued for 30 days. Larval whitefish from two areas showed differences in growth due to temperature experience. Growth was examined in the laboratory at 6, 9, and 12 C. A simple linear model for predicting growth was developed. Whitefish began feeding when 14-15 cm long, and fed near the bottom mainly on Chironomid larvae. Larval whitefish were raised at 2-14 C at 2 degree intervals, and were fed dry trout feed, Oregon Moist Pellets, mosquito larvae, and brine shrimp. Starved fish died earlier at higher temperatures; mortality ranged from 15% for 3 months on brine shrimp to 98% in 1.5 months on Oregon Moist Pellets. (Siefert-EPA) W74-08832

**POLLUTION EFFECTS ON ADULT STEEL-HEAD MIGRATION IN THE SNAKE RIVER,** Idaho Univ., Moscow, Coll. of Forestry. C. M. Falter, and R. R. Ringe. Copy Available from GPO Sup Doc as EPI.23:660/3-73-017, \$1.50; microfiche from NTIS as PB-232 990 \$1.45. Environmental Protection Agency, Ecological Research Series Report EPA-660/3-73-017, February 1974, 101 p, 23 fig, 3 tab, 16 ref. EPA Project 18050 DMB.

Descriptors: \*Rainbow trout, \*Kraft mill effluent, Oxygen, Water pollution effects, \*Migration behavior, Water temperature, Water velocity, \*Ultrasonic transmitters, Pre-impoundment water quality Anadromous fish, \*Idaho, \*Utah. Identifiers: \*Snake River (Idaho-Wash.), Lewiston (Idaho).

A three-year field study was conducted in 1969-1971 to assess the relationship of Kraft mill effluent and pre-impoundment water quality to adult steelhead trout (*Salmo gairdneri* Richardson) behavior in the Snake River, Idaho-Washington. Steelhead were tagged with ultrasonic tags and followed through a 25 km section of the proposed Lower Granite Reservoir. Limnological parameters were measured and compared with fish behavior. Mixing patterns of the Clearwater River with the Snake River were also assessed. Mean water quality changes in the Snake River as a result of pollution inputs in the study are very subtle. In terms of toxic effects from chemical loading, Snake River water quality is not greatly altered except in the immediate area of pollution input; steelhead avoidance of these localized problem areas, was not observed. No significant correlation could be made between any chemical water quality parameter and steel head behavior. However, as temperature dropped below 15 C fish movement slowed, fish generally stopped moving at night, and resting periods increased in length and number. Steelhead showed a preference to move in water with off-bottom current velocities of 0.2 to 0.5 m/sec and showed a definite pattern of crossover and resting points. (EPA) W74-08833

**EFFECTS OF TEMPERATURE ON DISEASES OF SALMONID FISHES,** Oregon State Univ., Corvallis. Dept. of Microbiology. J. L. Fryer, and K. S. Pilcher. Copy Available from GPO Sup Doc as EPI.23:660/3-73-020, \$1.55; microfiche from NTIS as PB-232 988 \$1.45. Environmental Protection Agency, Ecological Research Series Report EPA-660/3-73-020, January 1974, 114 p, 8 fig, 20 tab, 6 ref. EPA Project 18050 DIJ.

Descriptors: Animal diseases, Effluents, \*Fish diseases, Heated water, Infection, Microorganisms, Pathogenic bacteria, Pathology, \*Thermal pollution, Water pollution, Water quality, Water temperature, Water pollution effects, \*Salmon, \*Trout, \*Salmonids.

The effect of water temperature on infections of salmonid fish was investigated. *Chondrococcus columnaris* infection was studied in rainbow trout, coho and spring chinook salmon; *Aeromonas salmonicida* infection in coho and spring chinook salmon; and *Aeromonas liquefaciens* infection in steelhead trout. In all cases mortality rates were high at 64 F; moderate at 54 F; and low or zero at 39 to 49 F. Progress of the infections was accelerated at higher temperatures, and progressively retarded at decreasing temperature levels. In infection of coho with *Ceratomyxa shasta*, mortality was high at 69 F, low at 49 to 54, and zero at 39 to 44 F. This infection in rainbow trout resulted in high mortality at all temperatures except 39 degrees. In both cases the course of the disease was most rapid at higher temperatures, and became progressively slower as the temperature decreased. For infection of kokanee salmon fingerlings with sockeye salmon virus, the temperature range of 54 to 59 F was optimal. In this range mortality rates were high, and the course of the disease was most rapid. At higher temperatures mortality rates were lower, and at 39 to 44 F, progress of the disease was retarded, though total mortality was often high. (EPA) W74-08834

**THE ROLE OF ORGANIC DEBRIS AND ASSOCIATED MICRO-ORGANISMS IN PELAGIC ESTUARINE FOOD CHAINS,** Maryland Univ., Solomons. Natural Resources Inst. D. R. Heinle, D. A. Flemer, J. F. Ustach, R. A. Murtagh, and R. P. Harris. Available from the National Technical Information Service as PB-232 949 \$4.75 in paper copy, \$1.45 in microfiche. Maryland Water Resources Research Center, College Park, Technical Report No 22, (1973). 123 p, 12 fig, 11 tab, 45 ref. OWRR B-016-MD (1), 14-31-0001-3893.

Descriptors: \*Marshes, \*Detritus, \*Copepods, Estuaries, \*Food chains, \*Maryland, \*Productivity, Decomposing organic matter, Microorganisms, Primary productivity. Identifiers: \*Patuxent estuary (Md), \*Marsh production, Eurytemora affinis, *Scotollana canadensis*.

Production on marshes adjacent to the upper Patuxent estuary was 1,000 to 1,500 grams dry weight per m<sup>2</sup> per year. Approximately 6 to 9 percent of the annual production was exported to the estuary as particulate carbon. Production was comparable to other marsh systems but export (as percentage of production) was less, probably due to poor tidal exchange. In spite of the relatively low percentage of their fixed carbon contributed to the estuary, the marshes provide about one-third of the total carbon budget in the upper Patuxent. A large portion of the marsh carbon enters the estuarine system in early spring when levels of algal primary production are low. Substantial production of the calanoid copepod, *Eurytemora affinis* occurs with detrital carbon as the apparent food base. Feeding experiments indicate that *E. affinis* can reproduce when fed a diet of detritus enriched with bacteria and protozoa, or when fed only protozoa. Diets of detritus and micro-organisms alone were seldom equal to algal controls however, suggesting that detritus provides only part of the carbon requirement. A harpacticoid copepod, *Scotollana canadensis*, was found less capable of using detritus and associated microorganisms, but could obtain some energy from that source. (EPA) W74-08837

**EFFECT OF INDUSTRIAL WASTES OF MEMPHIS AND SHELBY COUNTY ON PRIMARY PLANKTONIC PRODUCERS,** Christian Bros. Coll., Memphis, Tenn. Robert Staub, John Appling, and Adrian M. Hofstetter. Completion Report, October 1969, 31 p, 4 fig, 3 tab, 9 ref. OWRR Project B-004-TENN (1).

Descriptors: Correlation analysis, Iron, \*Industrial wastes, Plankton, Turbidity, Chlorides, \*Tennessee, Mississippi River, \*Diatoms, \*Primary productivity. Identifiers: Diversity index, \*Navicula, Nonconah Creek (Tenn), *Synedra*, Wolf River (Tenn), \*Memphis (Tenn).

Plankton analyses were used to study industrial waste pollution during 1968-69 at eleven stations on the Mississippi River and two Memphis tributaries: Wolf River drainage (north) and Nonconah Creek (south). Correlation studies indicated that water temperature and chloride content correlated positively with total plankton (and diatom) counts; turbidity and iron content correlated negatively with these counts. Positive correlation was found between some counts and total hardness, pH, and silica content. The same general pattern appeared for centric and pennate diatoms and for the genera *Navicula* and *Synedra*. Possibility of an indicator for industrial waste pollution is confirmed by these results as well as by those of the second approach utilized: diversity index. Four classes of pollution in terms of ranges of diversity indices appeared: (1) heavy, with indices from 0.00 to 1.00; (2) moderate, from 1.00 to 2.00; (3) light, 2.00 to 3.00; and (4) slight to none, 3.00 to 4.50. Bar graphs giving magnitude of diversity indices for all samples helped in comparing degrees of pollution: e.g., one station with a heavy load of industrial waste effluent showed a significant difference in diversity index value from the same tributary upstream where little to no industrial wastes were present. (See also W70-10325) W74-08840

**NITROGEN: A PROBLEM OF DECREASING DILUTION,** Imperial Coll. of Science and Technology, London (England). Dept. of Mathematics. For primary bibliographic entry see Field 5B. W74-08864

**VERTICAL DISTRIBUTION OF MICROBIAL PLANKTON IN SOUTHERN PART OF LAKE BAIKAL IN 1969, (IN RUSSIAN),** Biologo-Geograficheskii Nauchno-Issledovatel'skii Institut, Irkutsk (USSR). E. A. Maksimova, and V. N. Maksimov. Mikrobiologiya, Vol 41, No 5, p 896-902, 1972. Illus. English summary. Identifiers: Biomass, Lakes, Microbial studies, \*Phyto-plankton, \*USSR (Lake Baikal), \*Vertical distribution.

Microbial plankton distribution in waters of the southern part of Lake Baikal (USSR) was studied for 1 yr. Two maxima of the microbial growth were confirmed: in the spring under ice (April) and in the summer (August-Sept.). The maxima are due to the growth phases of phytoplankton and to the water thermal properties. The biomass of microbial plankton was determined for the layer of 0-500 m. Microbial forms changed in the course of the year. The number of microbial cells during summer stagnation was higher than data obtained earlier by other authors; this can be interpreted as a result of human activity on the banks of Baikal and its tributaries. Copyright 1973, Biological Abstracts, Inc. W74-08870

**BORON RELEASE FROM DEIONIZERS,** California Univ., Los Angeles. Dept. of Environmental Horticulture. For primary bibliographic entry see Field 5B.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

W74-08873

**A FOSSIL PLANT ENVIRONMENTAL IMPACT STUDY.**  
Nebraska Public Power District, Columbus.  
E. Sloth, and M. Locke.  
Power Engineering, Vol 78, No 4, p 52-55, April, 1974. 5 fig.

Descriptors: \*Fossil fuels, Sampling, Reservoirs, Measurement, Analysis, \*Nebraska, Water districts.  
Identifiers: \*Environmental impact statements, \*Power districts, \*Sutherland reservoir(Neb).

The environmental impact study made by the Nebraska Public Power District for the proposed fossil fuel plant at Sutherland Reservoir is discussed. The studies are of much the same nature and scope as for a nuclear plant with a few exceptions: radioactivity measurement is deleted, and programs for baseline SO<sub>2</sub> and particulate matter measurements and monitoring are instituted. A program of metering, sampling, counting, analyzing and logging has been underway about a year. It will be about 5 years before the plant goes into operation. During that time, the gathered data and deductions from it will indicate the relative vulnerability of various targets to various plant influences. The data will indicate sampling frequencies that should be increased or decreased, and it will disclose the presence of cyclical and irregular fluctuations in biota counts. (Merritt-FIRL.)  
W74-08874

**SIGNIFICANCE OF ECOLOGICAL ANALYSES IN THE INTERPRETATION OF ENVIRONMENTAL RELEASES OF RADIONUCLIDES.**  
Oak Ridge National Lab., Tenn.  
S. I. Auerbach, H. A. Vanderploeg, S. V. Kaye, and J. P. Witherspoon.  
IEEE Transactions on Nuclear Science, Vol NS-21, No 1, p 18-22, February, 1974. 4 fig, 1 tab, 8 ref.

Descriptors: \*Ecology, Analysis, \*Radioisotopes, Aquatic environment, Cesium, Fishes, Potassium, Organic matter.  
Identifiers: Oligotrophic waters, Eutrophic waters, Bioaccumulation factors.

The role of ecological analyses in the collection and interpretation of environmental measurements that are part of the surveillance programs of aquatic ecosystems around nuclear facilities is discussed. Bioaccumulation factors are used to predict the radionuclide concentrations an organism accumulates from chronic releases. The bioaccumulation factor is the ratio of radionuclide concentration in the organism to that in water. Bioaccumulation factors range from less than 1 to greater than 100,000 depending on the element, organism, and the environmental and ecological factors. The bioaccumulation factors of cesium in fishes are illustrated as a function of potassium concentration in the water, feeding habits and eutrophy. The highest bioaccumulation factors are found in piscivorous fishes from oligotrophic waters, which are waters of low nutrient and organic content. Piscivorous fishes are expected to have the highest bioaccumulation factors because Cs concentration increases with trophic level. The generally lower bioaccumulation factors in eutrophic water may result from sorption of Cs to the more abundant particulate organic matter in these waters. Particulate organic matter strongly absorbs many radionuclides. (Merritt-FIRL.)  
W74-08878

**DISTRIBUTION OF PHOSPHATES IN LAKE MARIUT, A HEAVILY POLLUTED LAKE IN EGYPT.**  
Alexandria Univ. (Egypt), Dept. of Oceanography.  
For primary bibliographic entry see Field 5B.  
W74-08881

**CHLORINE RESIDUALS IN TREATED EFFLUENTS.**  
Illinois Univ., Urbana. Dept. of Civil Engineering.  
V. L. Snoeyink, and F. I. Markus.  
Water and Sewage Works, Vol 121, No 4, p 35-38, April, 1974. 3 tab, 16 ref.

Descriptors: \*Chlorine, \*Toxicity, \*Effluents, \*Streams, Inlet, \*Illinois, Chlorination, Reviews, Ammonia, Water pollution, Water pollution sources, Water pollution control, Activated carbon, Sulfur compounds, Investigations, \*Waste water treatment.  
Identifiers: Dechlorination, Sulfur dioxide.

Toxicity studies on chlorine residuals in treated effluents are reviewed and the results of a field survey are presented wherein the concentration and type of chlorine residual present in treated effluents were determined. Chlorine residuals in the concentration range of 1-5 mg/liter as Cl<sub>2</sub> are being discharged to receiving waters in central Illinois as a result of chlorination of effluents for disinfection. The residual is predominantly monochloramine and in most instances it is being discharged to streams which provide little dilution. Other research has shown that chlorine residual imparts a definite toxicity to the discharge; stream criteria of 0.002 to 0.2 mg/liter total chlorine residual have been recommended depending on the type of fish to be protected in the receiving water and on whether the residual is continuously or intermittently present. Dechlorination can be achieved by use of sulfur compounds or by activated carbon. The carbon will also remove any ammonia. (Merritt-FIRL.)  
W74-08891

**IMPACT OF BEACH NOURISHMENT ON DISTRIBUTION OF EMERITA TALPOIDA, THE COMMON MOLE CRAB.**  
Virginia Univ., Charlottesville.  
B. Hayden, and R. Dolan.  
Journal of the Waterways Harbors and Coastal Engineering Division, American Society of Civil Engineers Vol 100, No WW2, p 123-132, May, 1974. 7 fig, 1 tab, 10 ref.

Descriptors: \*Crabs, \*Ecological distribution, \*Hydrogen sulfide, Beaches, Legal aspects, Sands, Currents, Wildlife management, \*North Carolina.  
Identifiers: \*National Environmental Policy Act(1969), \*Ecological impact, \*Cape Hatteras(N.C.), Beach-nourishment, Emerita talpoida, Mole-crabs, Engineering projects.

Since the 1969 National Environmental Policy Act was passed, the determination of ecological impacts of engineering projects on such wildlife as the crab has become a practical and legal necessity. Emerita talpoida was studied at a Cape Hatteras, North Carolina beach-nourishment site. On the discharge of nourishment materials it was found: the sands are transported across and down the beach via swash and longshore currents; E. talpoida move down the beach, and result in increased densities at one location; at termination of discharge, recovery takes between three days and a week or two. Mole-crab population here experienced a migration rather than massive mortality. High hydrogen sulfide levels are postulated as cause for a temporary drop in population level. Redistribution of the population is the significant effect. (Prague-FIRL.)  
W74-08894

**SALINITY-OZONE INTERACTIVE EFFECTS ON YIELD AND WATER RELATIONS OF PINTO BEAN.**  
Agricultural Research Service, Riverside, Calif.  
Salinity Lab.  
G. J. Hoffman, E. V. Maas, and S. L. Rawlins.  
Journal of Environmental Quality, Vol 2, No 1, p 148-158, January-March, 1973. 4 fig, 2 tab, 16 ref.

Descriptors: \*Salinity, \*Air pollution effects, Air pollution, Plant growth, \*Beans, Leaves, \*Ozone, Oxidation, Osmotic pressure, Water pollution effects.  
Identifiers: Pinto beans.

The interaction of salinity and ozone on the growth of pinto bean was evaluated in a controlled temperature light room. Salinity treatments having osmotic potentials of -0.4, -2.0, and -4.0 bars were studied in combination with 2-hour daily exposures to 0, 0.15, 0.25, and 0.35 ppm of ozone. Ozone at 0.15 ppm decreased the yield of non-saline plants nearly 50%; and at 0.25 ppm and higher, no significant yield was obtained. The results were essentially the same for plants salinized to -2.0 bars. At -4.0 bars, the yield at 0.25 ppm was only reduced to half that of the ozone-free treatment. The results indicate no interaction between salinity and ozone below 0.15 ppm. Above 0.15 ppm, however, there is a large interaction. At salinities of -0.4 and -2.0 bars, water-use efficiency decreased as ozone increased. Ozone did not appear to influence leaf water potential or its components. (Skogerboe-Colorado State)  
W74-08922

**A STUDY OF THE EUTROPHICATION OF THE SURFACE WATERS OF PYRAMID LAKE.**  
Nevada Univ., Reno. Dept. of Chemical and Metallurgical Engineering.  
J. L. Hendrix, and M. F. Deigue.  
Available from the National Technical Information Service as PB-232 998; \$3.00 in paper copy, \$1.45 in microfiche. Completion Report, November 1973. 18 p, 1 fig, 4 tab, 17 ref. OWRR A-047-NEV(1). 14-31-0001-3828.

Descriptors: \*Eutrophication, Surface waters, Brackish water, Water pollution effects, \*Nevada, Algae, Phosphates, \*Cyanophyta, \*Light intensity, Growth rates, Anabaena, Water quality.  
Identifiers: \*Pyramid Lake(Nev), \*Algal growth, \*Nodularia spumigena, Chemostats.

The capacity of the Pyramid Lake, Nevada, environment to grow algae was studied. Pyramid Lake is a brackish terminal located in the Intermontane region. To understand the uniqueness of the lake's environment, both field and laboratory investigations were necessary. From field studies, the water quality, the pH of the lake, and the temperatures of the lake were obtained during the algal bloom in the summers of 1972 and 1973. By using phosphate concentration as the criteria, the lake could be classified as eutrophic. The main contributor to the bloom was the blue-green algae, Nodularia spumigena. Nodularia spumigena was isolated and cultured in the laboratory. Using the purified stock as inoculum, work using chemostats was conducted. In the fermentors, it has been determined that N. spumigena is sensitive to the light intensity. Light intensities of 100 foot candles for twelve hours per day cause the cell to bleach and then die. Actually, growth in the chemostats occurred only when the intensity was reduced to 35 foot candles. At that intensity the cells remained green and healthy looking. It was also determined that Nodularia spumigena can grow under diverse water qualities and strains of Anabaena can grow in the Pyramid Lake environment.  
W74-08938

**THE NUCLEAR FUEL CYCLE -- A SURVEY OF THE PUBLIC HEALTH, ENVIRONMENTAL AND NATIONAL SECURITY EFFECTS OF NUCLEAR POWER.**  
Union of Concerned Scientists, Cambridge, Mass.  
D. F. Ford, T. C. Hollocher, H. W. Kendall, J. J. MacKenzie, and L. Scheinman.  
Available: Union of Concerned Scientists, P.O. Box 289, MIT Branch Station, Cambridge, Mass. 02139. \$6/copy. October 1973. 212 p, 5 fig, 21 tab, 129 ref, 3 append.

Descriptors: \*Nuclear powerplants, Fuels, Cycles, \*Radioactive waste disposal, Effluents, Regulation, Safety, \*Uranium, Transportation, Mining, Waste storage, Hazards, Biology, \*Public health, Population, Food chains, Tritium, Krypton radioisotopes, \*Reviews, Environmental effects. Identifiers: \*Plutonium.

The report comprises reviews of the milling of uranium and the subsequent disposal of radioactive tailings, the storage and disposal of high level radioactive wastes, the exposure of uranium miners to radioactive gas, problems of diversion during routine transport of nuclear material for terrorist purposes, and some of the operating history of the first United States fuel reprocessing plant. In addition, a brief survey of the earlier and extensive UCS analyses of catastrophic nuclear power plant accidents is included. (See W74-08948 thru W74-08953) (Houser-ORNL) W74-08947

# STORAGE AND DISPOSAL OF HIGH LEVEL WASTES.

Brandeis Univ., Waltham, Mass. Dept. of Biochemistry. T. C. Hollacher.

In: The Nuclear Fuel Cycle -- A Survey of the Public Health, Environmental and National Security Effects of Nuclear Power, p 8-55, October 1973. 3 fig, 3 tab, 28 ref, 2 append.

Descriptors: \*Nuclear powerplants, \*Effluents, \*Radioactive waste disposal, \*Air pollution, \*Water pollution, \*Soil contamination, \*Environmental effect, Fuels, Hazards, Safety, Evaluation, Assessment, Waste storage, Corrosion, Leakage, Research and development. Identifiers: Fuel reprocessing.

Proposals for long-term storage or disposal of high-level waste from the nuclear power industry largely lie at the research and development stage. The proposals so far considered seriously by the AEC for the disposal of wastes are dubious in concept, not technically feasible, or they are so dependent upon site specific geological characteristics that suitability cannot be determined a priori without extensive on-site investigation. The impression is inescapable, in view of the present imprecise state of affairs, that no convincing statements exist regarding the long-term environmental impact attending the storage and/or disposal of wastes from fuel reprocessing. It is disturbing in this regard that the pace of development of a suitable waste disposal technology does not seem commensurate with the rate of expansion of the nuclear power industry. (See also W74-08947) (Houser-ORNL) W74-08948

# THE NUCLEAR SAFEGUARDS PROBLEM.

Cornell Univ., Ithaca, N.Y. Peace Studies Program. L. Scheinman.

In: The Nuclear Fuel Cycle -- A Survey of the Public Health, Environmental and National Security Effects of Nuclear Power, p 56-74, October 1973.

Descriptors: \*Nuclear energy, \*Radioactivity, \*Safety factors, \*Public health, \*Transportation, \*Sites, Reasonable use, Economics, Cost-benefit theory, Regulation, Air pollution, Water pollution, Soil contamination, Disasters, Uranium, Plutonium. Identifiers: Safeguards, Non-proliferation treaty, National security, Sabotage.

Nuclear power presents an added dimension to the issue of public health and security that arises from the fact that the same nuclear material that is capable of providing light for a city's thoroughfares, buildings, and residences is, when fabricated correctly and employed as a weapon, also capable of obliterating that city and its inhabitants. The task

of insuring that such use, or the threat of such use, shall never occur is referred to as the nuclear safeguards problem. It is a subject of international scope. One major problem of the U.S. today is diversion from peaceful uses or theft. Nuclear safeguards in transportation ranks equally high. (See also W74-08947) (Houser-ORNL) W74-08949

# CATASTROPHIC NUCLEAR ACCIDENTS.

Union of Concerned Scientists, Cambridge, Mass. D. F. Ford, and H. W. Kendall.

In: The Nuclear Fuel Cycle -- A Survey of the Public Health, Environmental and National Security Effects of Nuclear Power, p 75-91, October 1973. 16 ref.

Descriptors: \*Accidents, \*Hazards, \*Safety, \*Assessment, Regulation, Evaluation, Fuels, Nuclear powerplants, Public health, Safety factors, Toxicity, Administrative agencies, Federal government, Legal aspects. Identifiers: \*Nuclear fuel cycle, \*Catastrophic accident.

The emergency core cooling system (ECCS) is a matter of national controversy. The matters discussed at the ECCS hearing were highly technical and of great volume. It is not possible to summarize the technical arguments and positions in a satisfactory manner. However, a brief, largely non-technical summary is presented of these important matters drawing on the ECCS hearing record, several UCS analyses, and other sources. (See also W74-08947) (Houser-ORNL) W74-08950

# RADIATION HAZARDS FROM THE MISUSE OF URANIUM MILL TAILINGS.

Brandeis Univ., Waltham, Mass. Dept. of Biochemistry.

T. C. Hollacher, and J. J. MacKenzie.

In: The Nuclear Fuel Cycle -- A Survey of the Public Health, Environmental and National Security Effects, p 92-115, October 1973. 2 tab, 14 ref, append.

Descriptors: \*Uranium, \*Radium, Environmental effects, Air pollution, Water pollution, Toxicity, Public health, \*Mining, Mills, Mine wastes, Construction material, \*Radioactivity, Regulation, X-rays, Gases, Administrative agencies, \*Radioisotopes. Identifiers: Population exposure.

The extraction of uranium from ore results in a sand-like material, called tailings, which still contains most of the original radium, and in some fluids and slimes which also contain radium. Prior to 1959 the disposal and handling of these materials caused the pollution of streams and water supplies by radium in the Southwestern United States. Prior to 1966 uranium tailings were used as fill and for other construction purposes around buildings. Some 3300 buildings have been discovered to be associated with tailings in and around Grand Junction (Mesa County) Colorado, some 5,000 buildings in the whole of Colorado, and perhaps 7,000-8,000 buildings altogether in the United States. The tailings emit alpha-rays and radon gas which expose persons indoors. In view of the situation described above and in anticipation of the milling of uranium ore which is soon to begin for the nuclear power industry, recommendations are made to alleviate the exposure. (See also W74-08947) (Houser-ORNL) W74-08951

# LUNG CANCER AMONG URANIUM MINE WORKERS.

Brandeis Univ., Waltham, Mass. Environmental Studies Program.

A. S. Schurgin, and T. C. Hollacher.

In: The Nuclear Fuel Cycle -- A Survey of the Public Health, Environmental and National

Security Effects of Nuclear Power, p 116-148, October 1973. 1 fig, 4 tab, 41 ref.

Descriptors: \*Mining, \*Uranium, Human population, Human pathology, Epidemiology, Public health, Air pollution, Water pollution, Toxicity, Morbidity, Mortality, \*Air pollution effects, Environmental effects. Identifiers: Occupational exposure, Inhalation, \*Lung cancer.

Large scale mining of uranium for atomic weapons began in Southwestern U.S. in 1946 following the passage of the Atomic Energy Act, and continued through about 1968 when the existence of adequate stockpiles of uranium led to a reduction in mining activities. During this period, and especially from 1946-1960, some 6,000 underground miners were significantly and needlessly exposed to radioactive gases present in the air of uranium mines. After analysis of the foregoing, recommendations are made to help protect the health and lives of present underground uranium miners. (See also W74-08947) (Houser-ORNL) W74-08952

# NUCLEAR FUEL REPROCESSING: RADIOLOGICAL IMPACT OF WEST VALLEY PLANT.

In: The Nuclear Fuel Cycle -- A Survey of the Public Health, Environmental and National Security Effects of Nuclear Power, p 149-207, October 1973. 1 fig, 10 tab, 27 ref.

Descriptors: \*Fuels, \*Nuclear powerplants, \*Effluents, \*New York, \*Environmental effects, \*Radioactivity, Waste treatment, Sites, Population, Density, Uranium, Plutonium, Liquid wastes, Monitoring, Water pollution, Streams, Fish, Standards, Sediments, Tritium, Public health, Iodine, Krypton, Strontium, Cesium. Identifiers: Fuel reprocessing plant, \*West Valley (N.Y.), Deer.

The operations of the Nuclear Fuel Services (NFS) reprocessing plant, located in West Valley, New York, are described and its radiological impacts on its surroundings for its first five years of operation are reviewed. The radioactive releases to the air and water from the plant during the period 1966-1971 were significant enough for the AEC and the State of New York to have required major modifications. As a result of the installation of a low level waste treatment facility, some of the liquid radioactive emissions, since 1971, have been reduced. Nevertheless, the future plant capacity at NFS will eventually increase by a factor of 15 over 1971 throughput. Also, most of the fuel reprocessed at NFS to date has been cooled for much longer than the 150 days minimum required by the NFS license, suggesting that future emissions may be greater as cooling periods are shortened. Recommendations based on the analysis of the plant's past and present operations are given. (See also W74-08947) (Houser-ORNL) W74-08953

# ENVIRONMENTAL ASPECTS OF PLUTONIUM -- A SELECTED, ANNOTATED BIBLIOGRAPHY.

Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5B. W74-08957

# ENVIRONMENTAL ASPECTS OF PLUTONIUM AND OTHER ELEMENTS - A SELECTED ANNOTATED BIBLIOGRAPHY.

Oak Ridge National Lab., Tenn. For primary bibliographic entry see Field 5B. W74-08958

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

#### FINAL ENVIRONMENTAL STATEMENT RELATED TO THE PROPOSED HOPE CREEK GENERATING STATION UNITS 1 AND 2.

Directorate of Licensing (AEC), Washington, D.C.

Aval: NTIS, Springfield, Va., as Rept. No. Docket 50354-100; \$10.60/copy, \$1.45/microfiche. Report No. Docket 50354-100 and 50355-100, February 1974. 359 p, 30 fig, 47 tab, 141 ref, 3 append.

Descriptors: \*Nuclear powerplants, Effluents, Environment, Administrative agencies, Comprehensive planning, \*Sites, Geology, Investigations, Hydrology, Seismology, Climatology, Meteorology, Ecology, Radioactive wastes, Water pollution, Water pollution sources, Radioactive effects, Monitoring, Public health, Transportation, Beneficial use, Cost-benefit analysis, \*New Jersey.

Identifiers: \*Boiling water reactors, Artificial Island, \*Delaware River, \*Environmental impact statements.

This final environmental statement was prepared in compliance with the National Environmental Policy Act and relates to the proposed issuance of a construction permit for the Hope Creek Generating Station Units 1 and 2. The station is located in the state of New Jersey, on Artificial Island and will consist of two boiling-water reactors. Waste heat will dissipate into the atmosphere by a natural-draft cooling tower and blowdown water from the towers will be diluted with water withdrawn from and discharged to the Delaware River. Environmental impacts are assessed and after consideration of alternatives, an environmental benefit-cost summary was compiled. Environmental factors considered include climate, hydrology (surface water and ground water), ecology including aquatic life, cooling-water supply and discharge, cooling towers, cooling lakes, spray ponds, radioactive chemical and sanitary wastes, amount of dissolved oxygen and toxic chemicals in effluent water. The conclusion was to issue a construction permit for the facility subject to the following limitations: (1) additional study of proposed chlorination methods; (2) complete a preoperational ecological monitoring program; (3) obtain a water allocation waiving Tocks Island reservoir, and ensure compensating water storage capacity; (4) do certain redesign if necessary to protect aquatic ecosystems; (5) monitor for salt deposition; and (6) continuous efforts to guard against irreversible damage in plant construction and operation. (Houser-ORNL) W74-08959

#### FINAL ENVIRONMENTAL STATEMENT RELATED TO CONSTRUCTION OF ST. LUCIE PLANT, UNIT 2.

Directorate of Licensing (AEC), Washington, D.C.

Available from NTIS, Springfield, Va., as Report No. Docket 50389-69; \$7.60 per copy, \$1.45 microfiche. Report No. Docket 50389-69, May 1974. 301 p, 48 fig, 39 tab, 104 ref, 4 append.

Descriptors: \*Atlantic Ocean, \*Nuclear powerplants, Effluents, Environment, Administrative agencies, Comprehensive planning, \*Sites, Geology, Investigations, Hydrology, Seismology, Climatology, Meteorology, Ecology, Radioactive wastes, Water pollution, Water pollution sources, Radioactive effects, Monitoring, Public health, Transportation, Beneficial use, Cost-benefit analysis, \*Florida.

Identifiers: \*Pressurized water reactors, \*St. Lucie (Fla.), \*Environmental impact statements.

This final environmental statement was prepared in compliance with the National Environmental Policy Act and relates to the proposed construction of the St. Lucie Plant, Unit 2. The plant is located on Hutchinson Island on the east coast of Florida approximately midway between the cities of Fort Pierce and Stuart and will employ a pressurized water reactor cooled by water pumped

from and discharged to the Atlantic Ocean. Environmental impacts are assessed and after consideration of alternatives an environmental benefit-cost summary are compiled. Environmental factors considered include climate, hydrology (surface water and ground water), ecology including aquatic life, cooling-water supply and discharge, cooling towers, cooling lakes, spray ponds, radioactive chemical and sanitary wastes, amount of dissolved oxygen and toxic chemicals in effluent water. The conclusion is to issue a construction permit for the plant subject to stipulated conditions for the protection of the environment. These conditions concern screening to minimize sky shine, replanting of dune, minimize adverse effects of construction by analysis of the problem and submission of a plan of action to eliminate or reduce harmful effects. (Houser-ORNL) W74-08961

#### PROTOCOL FOR EVALUATING THE NITROGEN STATUS OF LAKE SEDIMENTS, Wisconsin Univ., Madison, Dept. of Soil Science.

D. R. Keeney.

Copy Available from GPO Sup Doc as EPI.23:660/3-73-024, \$0.65; microfiche from NTIS as PB-233 138 \$1.45. Environmental Protection Agency, Ecological Research Series Report EPA-660/3-73-024, February 1974. 25 p, 2 fig, 35 ref. EPA Project 16010 EHR Grant R-801362.

Descriptors: \*Lakes, \*Lake sediments, \*Water chemistry, \*Eutrophication, \*Nitrogen, Nitrification, Denitrification, Mineralization, Nitrogen fixation, \*Wisconsin.

Identifiers: Lake rehabilitation, Lake survey, Nitrogen sinks, Immobilization.

The approach and methodology to evaluate the nitrogen status of lake sediments, with the ultimate aim of estimating their role as a nitrogen source or sink to the overlying waters, is outlined. The information is derived from five years of research effort on the forms, amounts and transformations of nitrogen in lake sediments. The suggested approach involves monitoring or comparative characterization, or both, of the forms of nitrogen in lake sediments, along with laboratory tests to assess the relative rates of various key nitrogen processes such as nitrification, denitrification, mineralization and immobilization. (EPA) W74-09065

#### DAILY VERTICAL DISTRIBUTION OF WINTER ZOOPLANKTON IN THE PELAGIC ZONE OF LAKE BAIKAL, (IN RUSSIAN), Kaliningradskii Tekhnicheskii Institut Rybnoi Promyshlennosti i Khozyaistva (USSR).

M. B. Eggert.

Gidrobiol Zh. Vol 9 No 1 p 36-46, 1973. Illus. (English summary).

Identifiers: Copepods, Distribution patterns (Vertical), \*Infusoria, Lakes, Larvae, Nauplius, \*Pelagic zone, Phyto-plankton, Rotifers, \*USSR (Lake Baikal), \*Zooplankton.

There was a considerable predominance of infusoria among zooplankton. Daily vertical migrations of major species of rotifers and copepods were studied in connection with illumination conditions and distribution of fodder organisms (phytoplankton, nauplius larvae, etc.).--Copyright 1973. Biological Abstracts, Inc. W74-09074

#### STOCHASTIC MODEL OF DYNAMIC EUTROPHIC ESTUARY, Virginia Polytechnic Inst. and State Univ., Blacksburg.

For primary bibliographic entry see Field 5B. W74-09114

#### EFFECT OF ENVIRONMENTAL FACTORS ON LAKE ZOOBENTHOS IN THE SOUTHERN PART OF WESTERN SIBERIA (IN RUSSIAN), Novosibirsk Siberian Research Inst. of the Fish Industry (USSR).

L. A. Blagovidova.

Gidrobiol Zh. Vol 9, No 1, p 55-61, 1973. English summary.

Identifiers: \*Benthos, Biomass, Chironomids, \*Environmental effects, Fish, Lakes, Larvae, Leech, Mineralization, Mollusks, Production, \*USSR (Siberia), \*Zooplankton, Aquatic insects.

Data obtained from investigation of 20 lakes in the forest-steppe and steppe regions of Western Siberia (USSR) and data from the literature for 1920-1930 showed that a long period with lack of water in many lakes resulted in a considerably decreased water level, increased mineralization and decreased specific composition and biomass of the benthos (Mollusks, chironomids, leeches, insect larvae), with decreased fish production. Benthos biomass did not change in lakes with stable level conditions. Reclamative measures are suggested to maintain stable water conditions.--Copyright 1973. Biological Abstracts, Inc. W74-09120

#### BIOCOENOSSES OF THE PALUSTRINE BODIES OF WATER OF THE SOUTHERN PART OF THE LAKE ONEGA-WHITE SEA WATERSHED, (IN RUSSIAN),

N. A. Belousova, and Z. I. Filimonova.

Ekologiya. Vol 4, No 1, p 32-35, 1973.

Identifiers: \*Biocoenoses, Lakes, Palustrine environment, Aquatic animals, Watersheds (Basins), \*USSR (Lake Onega-White Sea), Aquatic plants, \*Marshes, \*Swamps.

The biocoenoses of small bodies of water in swamps differing in trophicity in the southern part of the Lake Onega-White Sea watershed (Karelia, USSR) were studied. The swamp expanses, bodies of water located on them, and the geobotanic and faunistic characteristics of the latter are described. The species composition for the aquatic fauna, also the numerosity of the leading groups and individual components are presented. The character and degree of development of the microfauna depend on the development of the hydrographic network in the swamps from the time of formation of the body of water and its overgrowth. The qualitative composition of the aquatic fauna can serve as one of the factors determining the history of formation of a swamp.--Copyright 1973. Biological Abstracts, Inc. W74-09127

#### BENTHOS IN ARAKUM BODIES OF WATER, (IN RUSSIAN),

Kaspiiskii Nauchno-Issledovatel'skii Institut Rybnoi Khozyaistva, Makhachkala (USSR).

M. K. Guseinov.

Gidrobiol Zh. Vol 9, No 2, p 80-86, 1973. Illus. English summary.

Identifiers: \*Benthos, Productivity, \*Seasonal, \*USSR, Terek River, Aquatic animals, \*Biomass, Estuarine environment.

Arakum (USSR) water bodies, situated within the estuarine part of the Terek river, showed fair stability of benthos species composition, its biomass and seasonal dynamics for the last 3 yr (1965-1969). It is suggested that bottom fauna formation stabilized in 1967, the third year of the water bodies existence. The low level of productivity depends on the lack of organic detritus content.--Copyright 1973. Biological Abstracts, Inc. W74-09142

#### FORMATION OF GAS CONDITIONS IN THE VILYUI RESERVOIR, (IN RUSSIAN),

Akademiya Nauk SSSR, Yakutsk, Institut Biologii.

T. M. Labutina.

Gidrobiol Zh. Vol 9, No 1, p 16-22. 1973. Illus. (English summary).

Identifiers: \*Anaerobic conditions, Carbon, Dioxide, Distribution patterns, \*Gas conditions, Organic matter, Reservoirs, Seasonal, Stratification, \*USSR (Vilyui reservoir), Dissolved oxygen.

Data are presented on the content and seasonal distribution of O<sub>2</sub> dissolved in water and free CO<sub>2</sub> over the aquatorium of the Vilyui reservoir (USSR) in the period of the reservoir formation. The reservoir is situated in the region of permafrozen soils (Western Yakutia). Essential changes in gas conditions and well pronounced vertical stratification of gas are observed. A slight flowage of the reservoir and the presence of a great quantity of flooded organic remains caused origin of large areas with anaerobic zones.—Copyright 1973, Biological Abstracts, Inc. W74-09162

#### BIOLOGICAL UPTAKE AND DISTRIBUTION OF LEAD IN ANIMALS,

Illinois Univ., Urbana.

J. Abdelnour.

In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 55-59, February 1973. 8 fig, 7 ref. NSF Grant GL-26 NSF RANN Grant GL-31605.

Descriptors: \*Lead, \*Path of pollutants, \*Mathematical models, \*Biochemistry, Metabolism, Poisons, Heavy metals, Biological properties, Water pollution effects, \*Absorption. Identifiers: \*Biological uptake (Heavy metals).

Models are able to predict the uptake, accumulation and distribution of trace metal contaminants in living organisms. These models, when coupled with studies on effects and alterations that these contaminants might inflict on the environment and its components, are extremely valuable to the decision maker. The body is divided into as many organs of interest as desired, and different types of input are considered. It is assumed that the transfer of the contaminant, namely lead, within the animal is accomplished via the blood and that the uptake and elimination of the contaminant follow a first order law. This implies that the instantaneous transfer rate from any given organ is directly proportional to the amount present in the organ. Mass equilibrium is satisfied at any given organ, and for the body as a whole. The mathematical model describing the uptake and elimination of lead is given by a set of first-order linear differential equations with constant parameters. Each equation states that the rate of change in accumulation within a given organ is equal to the uptake rate minus the elimination rate. (See also W74-09206) (Knapp-USGS) W74-09211

#### EFFECT OF MINE DRAINAGE ON THE QUALITY OF STREAMS IN COLORADO, 1971-72,

Geological Survey, Lakewood, Colo.

For primary bibliographic entry see Field 5B.

W74-09228

#### PACIFIC NORTHWEST LABORATORY ANNUAL REPORT FOR 1973 TO THE USAEC DIVISION OF BIOMEDICAL AND ENVIRONMENTAL RESEARCH - PART 2, ECOLOGICAL SCIENCES,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

B. E. Vaughan.

Available NTIS, Springfield, Va., as BNWL-1850, Pt. 2: \$7.60/copy, \$1.45/microfiche. Report No. BNWL-1850, Pt. 2, January 1974. 210 p, 60 fig, 55 tab, 187 ref.

Descriptors: \*Ecology, \*Ecosystems, \*Research and development, \*Freshwater, \*Sea water, \*Radioactivity, \*Radioecology, Physics, Instrumentation, Biology, Land resources, Water resources, Plutonium, Radioactivity effects, Radioactive waste disposal, Public health, Food chains.

This report is concerned with research in land and freshwater sciences and marine sciences programs. Within these activities the following sciences are involved: (1) Radiological sciences; (2) physics and instrumentation; (3) biology; (4) water and land resources; and (5) ecological systems. During the year an extensive body of data has been assembled in the terrestrial ecology programs, a major part of which has been made computer retrievable, and preliminary modelling schemes tested. Additional effort was made in modelling specific ecosystems. A new plutonium program concerned with the comparative behavior of americium, plutonium, and the other main transuranium elements was commenced. A wide range of studies on the transuranium elements is in progress covering transport, food chain, health, fuel cycle, and production or waste management aspects. (See W74-09234 thru W74-09239) (Houser-ORNL) W74-09233

#### ANALYSIS OF NATURAL SYSTEMS,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

L. L. Eberhardt, R. O. Gilbert, J. M. Thomas, and M. I. Cochran.

In: Report BNWL-1850, Part 2, p 1-17, January 1974. 4 fig, 3 ref.

Descriptors: \*Systems analysis, \*Statistical models, \*Ecosystems, Ecology, \*Nuclear powerplants, \*Effluents, \*Water pollution, Air pollution, Fallout, Soil contamination, Absorption, Sampling, Cycling nutrients, Food chains, Transfer, Ion exchange, Path of pollutants, Dairy industry, Plutonium, Statistics, Mathematical studies, Public health.

Long-term efforts to understand the quantitative aspects of natural systems are continuing, with a considerable emphasis on the ecological aspects of the development of nuclear power. Recent emphasis on sampling for contaminants has been brought to the point where an exposition of certain basic aspects is feasible, and one such report was presented to the International Statistical Institute's 39th Session in Vienna last August. Efforts to model ecological systems have concentrated on radionuclide cycling and transfers, and much of the effort was devoted to appraisal of a dairy farm study. Appraisals of various statistical and mathematical aspects of ecology continued along the lines of past years, with the addition of an effort to produce a bibliography of quantitative methods in ecology. (See also W74-09233) (Houser-ORNL) W74-09234

#### ENVIRONMENTAL CHEMISTRY,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

For primary bibliographic entry see Field 5B.

W74-09235

#### FRESHWATER ECOLOGY,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

C. D. Becker, R. G. Genoway, M. J. Schneider, C. E. Cushing, and D. G. Watson.

In: Report No. BNWL-1850, Pt. 2, p 57-100, January 1974. 21 fig, 11 tab, 24 ref.

Descriptors: \*Freshwater, \*Ecology, \*Temperature, Environment, \*Aquatic plants, \*Aquatic animals, Biota, Fish, Water pollution, Tritium, Radioactivity, Biology, Geochemistry.

Animal physiology, Plant physiology, Radioactivity effects, Radioactive waste disposal, Cycles, Ecosystems.

Studies are reported for effects of thermal discharges on aquatic biota and on fish behavior and sensory physiology, including combined effects of temperature, pollutants, and disease; effects of tritium on aquatic environments; and factors affecting biogeochemical cycling. Interaction of temperature with other environmental stresses and the relationship of temperature to physiological requirements are integral parts of this research program. Also consideration is given to the combined effects of temperature, chemical additives, e.g., biocides and corrosion inhibitors. The more radiosensitive embryonic and larval life stages of the aquatic environment were studied for the effects of tritium. The Columbia River and McNary Reservoir ecosystems were studied to determine the effects of ecosystems receiving radioactive wastes. (See also W74-09233) (Houser-ORNL) W74-09236

#### MARINE SCIENCES,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

W. B. Silker, D. E. Robertson, J. R. Van der Horst, R. Y. Ting, and C. W. Apts.

In: Report No. BNWL-1850, Pt. 2, p 101-120, January 1974. 2 fig, 7 tab, 5 ref.

Descriptors: \*Marine biology, \*Aquatic life, Environment, \*Nuclear powerplants, \*Effluents, \*Water pollution, Radioactive waste disposal, Radioactivity effects, Ecosystems, Oily water, Oil spills, Geochemistry, Physicochemical properties, Physical properties, Chemical properties, Radiochemical analysis, Oceans.

Efforts in the marine sciences are geared towards a better understanding of man's impact upon the environmental quality of the oceans. Radioactivity, anthropogenic pollutants, oil, and thermal discharges are waste products of an industrial society which enter the marine environment. The physical, chemical and biological interactions of these additions are being characterized to predict their potential detrimental effects in the oceans. The basic chemical and mixing processes in the ocean are being investigated to understand and determine how anthropogenic additions to the marine environment interact and disperse. Research on the thermal resistance of selected marine organisms and the effects of crude oil on marine intertidal communities are being conducted at the Marine Research Laboratory, Sequim, Washington. (See also W74-09233) (Houser-ORNL) W74-09237

#### RADIOLOGICAL SCIENCES,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.

C. E. Jenkins, J. C. Langford, D. E. Robertson, G. W. R. Endres, and C. W. Thomas.

In: Report No. BNWL-1850, Pt. 2, p 121-132, January 1974. 3 fig, 1 tab, 10 ref.

Descriptors: Environment, \*Radioactivity, \*Measurement, \*Public health, \*Assay, Research and development, \*Human population, Iron, Marine microorganisms, Seawater, Assessment, Altitude, Analytical techniques, Mercury, Trace elements, Stable isotopes, Cesium, Animal pathology, Environmental effects.

Studies are reported on radiological-health, iron-55 in human populations, radio-analytical procedures, and fate and effects of radionuclides in Alaska. Efforts continued in measurements of the decline of radioactivity in various population groups. Studies in iron-55 concentrations revealed specific activities increased 10 to 30 fold in salmon between mid and northern altitudes. Procedures have been developed to measure specific elements

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5C—Effects Of Pollution

such as Hg found to co-exist with certain trace radioactive or stable constituents. Comparison of radionuclide concentrations in rumen contents and muscle tissue of caribou from Anaktuvuk Pass and Kobuk River regions during 1972-1973 winter seasons show that in Kobuk caribou Cs-137 concentrations are two to three times higher. (See also W74-09233) (Houser-ORNL)  
W74-09238

#### TERRESTRIAL ECOLOGY,

Battelle-Pacific Northwest Lab., Richland, Wash. Environmental and Life Sciences Div.  
J. F. Cline, W. H. Rickard, D. W. Uresk, J. D. Hedlund, and W. T. Hinds.  
In: Report No. BNWL-1850, Pt. 2, p 133-171, January 1974. 21 fig, 11 tab, 13 ref.

Descriptors: Environment, \*Ecology, Ecosystems, Research and development, \*Biota, \*Animal populations, \*Speciation, \*Plant populations, Primary productivity, Food chains, Soil contamination, Absorption, Transfer, Ion transport, Root systems, Burrows, Radioactivity effects, Radioactive waste disposal, Water pollution, Cycling nutrients, Model studies, Decaying organic matter, \*Washington.

Terrestrial studies continue to contribute ideas and ecological data relevant to nuclear-power plant siting and the management of stored radioactive wastes in the semi-arid steppe region of Washington. These ideas and data are also largely applicable to steppe regions of Oregon, Idaho, and Nevada. Much of the available information concerning the ecology of steppe ecosystems has been gathered within the boundaries of the Arid Land Ecology Reserve, a place where long-term studies can be initiated with great assurance that the studies will not be interrupted by changing land use priorities. Today the concept of an ecological research area needs to be considered for waste management areas where opportunities are available to study the ecological behavior of radionuclides in the absence of resident human populations. These studies are relevant with the knowledge that rad-wastes will increase as a result of an expanding market for nuclear fueled power plants. This report reflects the integration of terrestrial ecology studies. Papers are grouped under the headings: energy and water relations, mineral nutrients, manipulation studies, consumers, primary producers, radiation studies, and modelling. (See also W74-09233) (Houser-ORNL)  
W74-09239

### 5D. Waste Treatment Processes

#### MODELING OF HYDROLOGIC PROCESSES AND WATER SALVAGE PROCEDURES IN SEMIARID REGIONS,

Arizona Univ., Tucson. Water Resources Research Center.  
S. D. Resnick.

Available from the National Technical Information Service as PB-232 834; \$3.00 in paper copy, \$1.45 in microfiche. Partial Technical Completion Report, December 1973. 7 p, 3 ref. OWRR A-020-ARIZ(8). 14-31-0001-3203.

Descriptors: \*Arizona, \*Water management (Applied), \*Salvage value, Model studies, \*Water reuse, Water costs, \*Water utilization, Semiarid climates, Waste water treatment, Water quality standards, \*Cost-benefits analysis.  
Identifiers: \*Tucson(Ariz).

Potential uses or reuses of salvageable waters in the Tucson region were examined, and costs and benefits related to such uses were evaluated. The quality of salvageable waters as determined in exploratory sampling was compared with water quality standards and criteria appropriate for agricultural, recreational and selected industrial uses. A tableau was then constructed which

showed the type and estimated cost of conventional water treatment that would be required for each source-to-use combination. Finally, an estimate was made of unit net benefits to be anticipated from salvageable water input to these uses, and the net benefits were applied in several test calculations to illustrate mixed allocations of the various salvaged waters to the selected uses.  
W74-08702

#### SEWAGE WATER IRRIGATION EFFECT ON COTTON GROWTH AND DEVELOPMENT, (IN RUSSIAN),

Desert Inst., Ashkhabad (USSR).  
S. Khodzhaikuliev.  
Probosloveniia Pustyn'. 5 p, 66-68. 1972. (English summary).  
Identifiers: \*Cotton growth, Growth, \*Irrigation, \*Mineralization, \*Sewage water, Salts.

A ground water mineralization rate of 4 g/l can be used to irrigate cotton fields. An irrigation rate of 6000 m<sup>3</sup>/ha is recommended. Irrigation and treatments which decrease soil evaporation rate reduce the accumulation of salts.—Copyright 1973, Biological Abstracts, Inc.  
W74-08729

#### TREATMENT OF BEET FACTORY-WASTE WATER BY ACTIVATED SLUDGE PROCESS (BIOSORPTION PROCESS), (IN JAPANESE),

Hokkaido Sugar Co. Ltd. (Japan).  
M. Nogai.  
Proceedings of the Research Society of Japan Sugar Refineries' Technologists, Vol 24, No 24, p 25-35, August 1973. 3 fig, 5 tab, 7 ref. English summary.

Descriptors: \*Waste water treatment, \*Water purification, \*Recycling, \*Activated sludge, Biochemical oxygen demand, Sugar beets, Industrial wastes, Design standards, Operation and maintenance, Hydrogen ion concentration, Temperature.  
Identifiers: \*Japan, Bulking, Phosphoric acid.

The purification of the waste water of the Honbetsu beet sugar factory by an activated sludge process is described. The process was effectively operated for four years, even in outdoor temperatures of -28°C. The design standards of the installation are described. The recycle ratio of sludge was more than 70%. Since the capacity of the clarifier was insufficient, it was necessary to increase the up flow rate in the clarifier over the design rate. The dissolved oxygen in the sludge aeration tanks was 0.4-0.6 ppm. The expected minimum elimination of BOD<sub>5</sub> was attained at 13°C. The pH level of waste water should be kept at 6-9. The elimination ratio BOD<sub>5</sub> obtained was 60-70% of the expected ratio. The excess sludge in running and final sludge were collected in a final pond, and they were decomposed by digestion in summer. When there was a fluctuation of pH value and a drop in waste water temperature, the activated sludge underwent bulking. The bulking stopped with the addition of phosphoric acid and it is concluded that soil adhering to beets and the beets themselves contain some nutrients that effectively activate the sludge. (Merritt-FIRL)  
W74-08777

#### STUDIES OF RENOVATION OF PULP MILL WASTEWATER PILOT PLANT TESTS FOR GRANULAR ACTIVATED CARBON ADSORPTION OF KRAFT PULP MILL WASTEWATER, (IN JAPANESE),

Government Industrial Research Inst., Siko (Japan).  
H. Kabeya, T. Fujii, and Y. Kimura.  
Japanese Technical Association Industry Journal, Vol 27, No 11, p 543-553, November 1973. 10 fig, 7 tab, 7 ref. English summary.

Descriptors: \*Pulp wastes, Investigations, \*Adsorption, \*Activated carbon, Lignins, Chemical oxygen demand, Activated sludge, Lime, \*Waste water treatment.  
Identifiers: \*Japan.

Pilot plant tests for adsorption on granular activated carbon were conducted with lime treated water of unbleached kraft pulp wash waste water (lignin concentration 12-26 ppm, COD 25-44 ppm) and pretreated water of bleached kraft pulp caustic soda extract waste water (lignin concentration 33-120 ppm), treated by activated sludge and followed by lime. The possibility of renovation of these treated waters was investigated. At a superficial velocity of 1.7 m/hr and contact time of 140 min, the carbon usages of lime treated water were 3530 liter/kg air-dried carbon on the basis of lignin breakthrough curve and 3090 liter/kg air-dried carbon on the basis of COD breakthrough curve. The adsorption of lignin on activated carbon by lime treatment increases, but the adsorption of COD hardly increases. These results are consistent with the results obtained from adsorption isotherms of lime treated water and dilute water. Similarly, the carbon usage of pretreated water of caustic soda extract waste water was 130 liters/kg air-dried carbon on the basis of lignin breakthrough curve. (Merritt-FIRL)  
W74-08778

#### DEVELOPMENT TRENDS IN POLLUTION-FREE PROCESSES.

Chemical Economy and Engineering Review, Vol 5, No 67, p 59-60, November, 1973. 2 tab.

Descriptors: \*Recycling, \*Industrial production, \*Pollution abatement, Sewage, \*Water reuse, Waste water treatment.  
Identifiers: \*Japan.

The development of closed systems of production in Japan as a method of pollution control is discussed. Central to this system is the recycling of materials used in the production process. According to a survey made by the Agency of Industrial Science and Technology, the process accounts for 31.9% of pollution abatement devices now being developed. The share is likely to increase to 42.5% five years later. There are plans to recover urban sewage as industrial water or to utilize gypsum by-product from the desulfurization of flue gas. The closed system is designed to prevent secondary and tertiary pollution. As such it is part of a comprehensive system of pollution control. Efforts to clean the environment also involve attempts to change the sources of heat and some of the raw materials and, more importantly, to change the nation's industrial structure. (Merritt-FIRL)  
W74-08783

#### DEEP-BED FILTRATION,

BAMAG Verfahrenstechnik G.m.b.H., Butzbach (West Germany).  
For primary bibliographic entry see Field 5F.  
W74-08784

#### HERE AND THERE.

Effluent and Water Treatment Journal, Vol 13, No 12, p 751-752, December, 1973.

Descriptors: \*Effluents, \*Water treatment, Industrial wastes, \*Sewage disposal, Land use, Sludges, Dewatering, Organizations, Polymers, Polyelectrolytes, Flocculation, Water purification, Potable water, \*Waste water treatment.

Research and newsbriefs on effluent and water treatment throughout the world are summarized. The question whether industry should use public sewers or provide its own treatment plants is being debated. There is renewed interest in the United States in the use of land as a means of disposing of sewage. The growth of the use of synthetic

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

polymers in the dewatering of sludges illustrates that it takes a long time to prove the worth of chemicals that are gradually replacing those inorganic chemicals and precipitants and flocculants that greatly increase the amount of sludge to be handled. A consultant group convened by the WHO International Reference Centre for Community Water Supply recommends that polyelectrolytes should be employed in the purification of water for public supply only after careful consideration of possible toxic hazards. The Water Research Association and the Testing and Research Institute of the Netherlands Water Undertakings will hold a conference to discuss improvements in techniques for the distribution of drinking water. (Merritt-FIRL)  
W74-08785

**TURNKEY CONTRACTS FOR SEWAGE TREATMENT PLANTS,**  
S. Pinnell.  
Civil Engineering-ASCE, Vol 44, No 1, p 86, January, 1974.

Descriptors: \*Contracts, \*Sewage treatment, Costs, Utilities, \*Waste water treatment, \*Treatment facilities.  
Identifiers: Turnkey contracts.

The disadvantages of turnkey contracting procedures for sewage treatment plants are summarized. Conventional contracting can provide better organization of pollution control efforts. The direct costs of turnkey contracting will normally be substantially higher than conventional contracting. Turnkey contracting does not generally result in design innovation unless special provisions are written into the design construction contract. Turnkey contracts would tend to limit competition to large design constructors. This restriction is too serious to justify the use of turnkey contracting in public works, especially when other contractual arrangements or improvements in conventional contracting could produce similar time reduction and at less cost. (Merritt-FIRL)  
W74-08786

**RESEARCH ROUND UP.**  
Effluent and Water Treatment Journal, Vol 13, No 12, p 791, December, 1973. 1 fig.

Descriptors: \*Waste water treatment, \*Water treatment, \*Denitrification, Nitrogen, Packed beds, Nitrilotriacetic acid, Investigations, Bacteria, Sludge, Activated sludge, Sand, Filtration, Coals, Slurries, Canada.  
Identifiers: England, India, Mutants.

Current research in waste and water treatment is summarized. Studies on the kinetics of packed bed denitrification at the University of California concluded that the denitrification process can be operated near the maximum unit removal rate and still obtain acceptable nitrogen conversion, regardless of the reactor configuration. A bacterial mutant was isolated at the Canadian Centre for Inland Waters from waste water after ultraviolet mutagenesis and penicillin selection and was shown to have higher affinity for nitrilotriacetic acid using concentrations up to 2.5 percent as sole carbon, nitrogen, and energy source over a wide temperature and pH range, without acclimatization. At the National Environmental Research Center in Cincinnati, pilot-plant experiments on the effect of waterworks sludge on the activated sludge process show there are no adverse effects. The Central Public Health Engineering Research Institute at Nagpur successfully substituted bituminous coal for anthracite for use with sand for dual media filtration. (Merritt-FIRL)  
W74-08787

**DIRECT FILTRATION: AN ECONOMIC ANSWER TO A CITY'S WATER NEEDS,**  
Springfield Municipal Water Works, Mass. Water Dept.

G. E. Sweeney, and P. W. Prendiville.  
Journal of the American Water Works Association, Vol 66, No 2, p 65-71, February, 1974. 4 fig.

Descriptors: \*Municipal water, \*Filtration, \*Waste water treatment, Water works, History, \*Massachusetts, \*Treatment facilities, Costs, Water treatment.  
Identifiers: \*Springfield(Mass).

The history of the Springfield, Mass., water system and the background of engineering investigations are described. The first community water supply in the city was developed in 1848. The city took over operations in 1872, and the reservoir had a yield of 10 mgd. The total average daily water consumption increased from 17 mgd in 1940 to 41 mgd in 1971. Currently about 33% of the supply is used by industry. An engineering report of 1970 recommended the immediate construction of a 60 mgd direct filtration plant, to be operated in conjunction with the slow sand filters. It was also recommended that the new facilities be designed to facilitate expansion of the plant to an ultimate capacity of 180 mgd. The report set a reasonable budget and schedule for the project. The plant is scheduled to go into operation in early 1974. The construction cost of the direct filtration facilities is now estimated at about \$88,000/mil gal of capacity, considerably lower than expected for a plant of this size. (Merritt-FIRL)  
W74-08788

**PHOSPHATE REMOVAL BY MAGNETIC FILTRATION,**  
Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.  
G. Bittou, R. Mitchell, C. de Latour, and E. Maxwell.  
Water Research, Vol 8, No 2, p 107-109, 1974. 2 fig, 2 tab, 12 ref.

Descriptors: \*Phosphates, Investigations, \*Filtration, Sampling, Color, Rivers, \*Separation techniques, Suspended solids, Tertiary treatment, Clays, Montmorillonite, Effluents, \*Massachusetts, \*Waste water treatment.  
Identifiers: \*Charles River(Mass), \*Magnetic separation, Magnetite, Alum.

The removal of phosphate from natural water by magnetic separation was investigated under carefully controlled conditions. Water from the Charles River, Boston, was sampled at three different locations and was treated by magnetic filtration to reduce its phosphate content. The removal of phosphorus approached the 90 percent level in the three locations. The suspended solid content and the color of the Charles River samples were reduced significantly. The effluents obtained by magnetic filtration were all very clear and did not contain any trace of montmorillonite. It is concluded that magnetic filtration is a rapid process that requires only a few minutes retention after the addition of magnetite, alum, and clay to the water samples. The process could be used as an alternative to settling tanks in the tertiary treatment of wastes. (Merritt-FIRL)  
W74-08789

**TUNNEL FAILURE DELAYS SEWER SYSTEM STARTUP.**  
For primary bibliographic entry see Field 8C.  
W74-08790

**TALE OF TWIN CITIES, CUTTING THE HIGH COSTS OF POLLUTION CONTROL.**  
Instrumentation, Vol 27, No 1, p 12-15, 1974. 5 fig.

Descriptors: \*Waste water treatment, \*Sewage treatment, Aeration, Sludge disposal, Incineration, Effluents, Chlorination, Flow, \*Treatment facilities, \*Minnesota.  
Identifiers: \*St. Paul(Minn), \*Minneapolis(Minn).

The centralized waste water treatment facility of the Twin Cities area in Minnesota is described. It serves a 3000 sq mile area with a population of over 2 million people and a commercial/industrial population equivalent to an additional million persons. The plant is completely integrated, meaning that its processes include secondary as well as primary treatment, sludge incineration, and chlorination of the effluent prior to discharge into the Mississippi River. Average flow capacity through the plant is 218 mgd. A major expansion program over the next five years will boost this to 290 mgd in a first step, with a potential flow capacity of 350 mgd in the long range future. (Merritt-FIRL)  
W74-08796

**THE INVESTIGATION OF BIODEGRADABILITY OF BRANCHED NONYL PHENOL ETHOXYLATES,**  
Swedish Water and Air Pollution Research Lab., Stockholm.  
L. Rudling, and P. Solym.  
Water Research, Vol 8, No 2, p 115-119, 1974. 4 fig, 2 tab, 7 ref.

Descriptors: \*Activated sludge, Investigations, \*Biodegradation, \*Phenols, Municipal wastes, Sewage, Surfactants, \*Waste water treatment.  
Identifiers: \*Sweden, \*Nonyl phenol ethoxylates.

The biodegradability of branched chain nonyl phenol ethoxylates was investigated according to a screening test procedure recommended by Organization for Economic Cooperation and Development (OECD). Also a study was conducted in a laboratory-scale activated sludge system operated with presettled municipal sewage under treatment plant conditions. The results show that there is no significant difference between the biodegradability of the different nonyl phenol ethoxylates containing 8-30 ethylene oxide groups. The removal of surfactants exceeds 90% and no acclimatization was needed in activated sludge treatment under plant conditions. (Merritt-FIRL)  
W74-08798

**NITROGENOUS COMPOUNDS IN THE ENVIRONMENT.**  
Environmental Protection Agency, Washington, D.C. Hazardous Materials Advisory Committee.  
For primary bibliographic entry see Field 5B.  
W74-08835

**TRANSIENT ANALYSIS OF A STATE PARK EXTENDED AERATION WASTEWATER FACILITY,**  
Maryland Univ., College Park. Dept. of Chemical Engineering.  
W. W. Hellier, Jr., and T. W. Cadman.  
Available from the National Technical Information Service as PB-232 957 \$5.75 in paper copy, \$1.45 in microfiche. University of Maryland Water Resources Research Center Technical Report No 24. (1973) 186 p, 44 fig, 3 tab, 151 ref, 3 append. OWRR A-021-MD (1), 14-31-0001-3520. \*Waste water treatment, Treatment facilities, Biological treatment, \*State parks, \*Pennsylvania, \*Aeration, \*Biochemical.  
Identifiers: \*Extended aeration, Prince Gallitzin St. Pk.(Penn).

Experimental data on the transient operation of the extended aeration wastewater treatment plant at Pennsylvania's Prince Gallitzin State Park have been collected and the system has been mathematically modeled. Time-variant inlet hydraulic flows were obtained through continuous measurement, and organic loading data were based on grab samples analyzed for biochemical oxygen demand (BOD) and volatile suspended solids concentration. Effluent BOD was used as the criterion for comparing the predicted with the observed time-variant plant response to loadings. Three mathematical models were developed for the simulations. The first represented the plant as well mixed

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

system with BOD destruction given by first order kinetics. The second represented the plant as a series of equal volume well mixed stages, with all BOD in solution and being destroyed by a first order kinetic reaction. The third represented the plant as a well mixed system with BOD both in solution and in the suspended solid phase. Direct destruction of dissolved and solid BOD was considered to be by separate first order kinetic reactions. A second-order conversion of solid to dissolved BOD was also assumed. The well mixed model is selected as the preferred model based upon the data now available for the system. W74-08838

#### DEVELOPMENT OF A HIGH PRODUCT WATER RECOVERY SYSTEM FOR THE TREATMENT OF ACID MINE DRAINAGE BY REVERSE OSMOSIS

Envirex, Inc., Milwaukee, Wis. Environmental Sciences Div.  
M. K. Gupta.  
Available from the National Technical Information Service as PB-230 756/AS, \$6.25 in paper copy, \$1.45 in microfiche. Office of Saline Water, Report INT-OSW-RDPR-74-939, March 1974. 51 p, 7 fig, 11 tab, 14 ref. OSW Contract 14-30-3020.

Descriptors: \*Demineralization, \*Desalination, Descaling, Membrane process, Membranes, Pilot plants, \*Reverse osmosis, Saline water, Scaling, Ion exchange, Water reuse, \*Waste water treatment, \*Mine drainage, Acid mine water, Neutralization, \*Water softening.  
Identifiers: Sodium hexameta-phosphate, Membrane fouling, Citric acid, Soda ash softening, Sodium aluminate softening, Carbon dioxide softening, Ion exchange softening, Sludge recycling, Cost estimate.

The objective was to develop a high product water recovery reverse osmosis (RO) system for the treatment of acid mine drainage. Depending on raw water quality the overall water recovery was limited to about 95% because of the buildup of saturation concentrations of calcium sulfate. Brines saturated with  $\text{CaSO}_4$  were produced via a portable RO unit employing hollow fiber B-9 membranes for a number of neutralization and softening tests. Various alkaline agents such as lime, limestone, sodium hydroxide and soda ash were evaluated for the neutralization of the brines produced from the first stage RO processing of raw acid mine waters. The presence of ferric iron in the feed above a pH level of 2.6 contributed to the fouling of the membranes. Addition of sodium sulfite aided in reducing the iron to the ferrous state. Biochemical oxidation and limestone-lime combination treatment to a pH of 10.8 was concluded to be the most suitable and economic method of neutralization. Treatment costs for a 10 million GPD capacity plant were: 15.7 cents per 1000 gallons - capital costs; and 59 cents per 1000 gal - operating costs. (OSW) W74-08841

#### PHOSPHORUS REMOVAL DESIGN SEMINAR, CONFERENCE PROCEEDINGS NO. 1

Environmental Protection Service, Ottawa (Ontario).  
Research Program for the Abatement of Municipal Pollution under Provisions of the Canada-Ontario Agreement on Great Lakes Water Quality, Conference held May 28-29, 1973, Toronto, Canada. 359 p. (1973).

Descriptors: \*Phosphorus compounds, \*Waste water treatment, Treatment facilities, Biological treatment, Sludge treatment, Information exchange, \*International Joint Commission, Activated sludge, Design criteria, Sewage treatment, \*Research and development, \*Canada.  
Identifiers: \*Phosphorus removal.

In response to the International Joint Commission recommendations, the Canadian federal govern-

ment and the government of Ontario signed an agreement in August, 1971. Under the terms of the Canada-Ontario Agreement on Great Lakes Water Quality, the two governments undertook to accelerate the construction of pollution control facilities in the Great Lakes Basin, and provide funding for treatability studies and research designed to improve pollution control technology. The province of Ontario and Ontario municipalities are presently involved in a five-year program to control, by 1975, phosphorus discharges from more than 200 existing wastewater treatment plants serving some 4.7 million people. For the most critically affected areas of the province, permanent phosphorus removal facilities must be operational by December 31, 1973. In view of this deadline and the fact that the development of design parameters for phosphorus removal facilities is in its infancy it became apparent that a seminar of this nature should be of considerable assistance to those involved in the design of these facilities. This seminar was intended to provide an exchange of information between consulting engineers and government personnel involved in the design and approval of phosphorus removal facilities at waste treatment plants. (See W74-08847 thru W74-08862) W74-08846

#### PHOSPHORUS REMOVAL IN ONTARIO

Ministry of the Environment, Toronto (Ontario). Sanitary Engineering Branch.  
G. L. Van Fleet.  
In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1, (1973). 25 p, 1 fig, 6 ref.

Descriptors: \*Research and development, \*Waste water treatment, \*Treatment facilities, \*Methodology, Data collections, Design criteria, Economics, Efficiencies, Chemical precipitation, \*Canada.  
Identifiers: \*Phosphorus removal.

The integration of chemical treatment into existing waste water treatment plants in Ontario has necessitated the development of a research methodology capable of providing in a very short time period sufficient design information to successfully implement the Province's phosphorus removal program. This methodology has involved both treatability studies and intensive research investigations. The treatability studies are proceeding at all waste water treatment plants requiring phosphorus removal and it is expected that the resultant data will contribute to the design of the most efficient and economical chemical process for each particular plant within the required timing. Research and demonstration projects have made it possible to demand permanent facilities to meet the required percent phosphorus removal or effluent quality criteria. Continuing investigations will produce more accurate information on sludge handling and disposal and will improve upon existing waste water treatment technology. (See also W74-08846) (Sandoski-FIRL) W74-08847

#### GUIDELINES FOR CONDUCTING TREATABILITY STUDIES FOR PHOSPHORUS REMOVAL AT WASTEWATER TREATMENT PLANTS

Ministry of the Environment, Toronto (Ontario).  
In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1, (1973). 24 p, 1 fig, 2 tab.

Descriptors: \*Waste water treatment, \*Treatment facilities, Investigations, Coagulation, Chemical treatment, Pilot plants, Methodology, Sludge disposal, Sludge treatment, \*Canada.  
Identifiers: \*Phosphorus removal, \*Investigation guidelines.

An information brief for consulting engineers and municipal officials as well as a supplement to Guidelines For Initiating Treatability studies is given. These guidelines are designed to assist per-

sonnel involved in carrying out phosphorus removal treatability studies in determining the most efficient and economical means to implement phosphorus removal through chemical addition at existing waste water treatment plants. The methodology, which includes both jar testing and pilot study phases, allows the prediction of the prime coagulant best suited for phosphorus removal at any particular treatment facility and a determination of whether the chemical used has any effect on the existing waste water treatment process, facilities, method of sludge treatment, and subsequent sludge disposal practices. The choice of chemical is limited to the process most compatible with sewage characteristics and the existing facilities, taking into account the physical layout of the plant and the delivered cost and availability of the particular chemical. (See also W74-08846) (Sandoski-FIRL) W74-08848

#### PHOSPHORUS REMOVAL BY CHEMICAL ADDITION USING PRIMARY TREATMENT

A. Wilkes.  
In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1, (1973). 17 p, 1 fig.

Descriptors: \*Chemical precipitation, \*Sewage treatment, \*Phosphates, Chemical reactions, Flocculation, Methodology, \*Waste water treatment, \*Canada.  
Identifiers: \*Phosphorus removal.

Phosphorus removal by chemical addition ahead of primary clarification is a viable technique for controlling phosphorus discharges at sewage treatment plants. For the purposes of this study, primary treatment for phosphorus removal is defined in terms of the point of addition of chemical. The types of phosphorus compounds present in sewage such as ortho-phosphates, polyphosphates, and organic phosphates are discussed. The mechanism of phosphorus removal which includes precipitation of phosphorus compounds, chemical reactions, and solids flocculation, together with practical considerations and experience are mentioned. (See also W74-08846) (Sandoski-FIRL) W74-08849

#### CHEMICAL PRECIPITATION FOR BIOLOGICAL AND POSTBIOLOGICAL TREATMENT

J. D. Norman.  
In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 14 p, 6 fig.

Descriptors: \*Chemical precipitation, \*On-site testing, \*Treatment facilities, \*Performance, Equipment, Effluents, Optimization, Efficiencies, \*Canada, \*Waste water treatment.  
Identifiers: \*Phosphorus removal.

Chemical precipitation at full-scale treatment plants in several plants in Ontario, Canada has been observed. Comments are made on some of the factors (chemical choice, point and rate of application, control of chemical feed, and the effect of plant operation) affecting the performance of chemical precipitation processes and the effect or lack of effect of several variables tested. Conclusions suggest the following: chemical solutions are not difficult to obtain, the jar testing procedure is consistent for a given waste, equipment for chemical application is inexpensive and portable, systems should also provide improved effluent quality, and system optimization requires a longer testing period than eight weeks. (See also W74-08846) (Sandoski-FIRL) W74-08850

#### PHOSPHORUS REMOVAL IN SEASONAL RETENTION LAGOONS BY BATCH CHEMICAL PRECIPITATION

Ministry of the Environment, Toronto (Ontario). H. J. Graham, and R. B. Hunsinger.

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Waste Treatment Processes—Group 5D

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 25 p, 4 fig, 1 tab, 12 ref.

Descriptors: \*Aluminum, \*lime, \*Chlorides, \*Iron, \*Testing, \*Chemical precipitation, Effluents, Phosphorus, Biochemical oxygen demand, Performance, \*Canada, \*Waste water treatment.

Identifiers: \*Phosphorus removal.

Alum, ferric chloride, and lime have been tested as a means of phosphorus removal in the batch chemical treatment of seasonal retention lagoons. The required dosages were determined by jar tests, a highly reliable method in predicting the post-treatment results in a lagoon. Lagoon discharge was usually begun the day after treatment and continued for an average of eight days. Both alum and ferric chloride produced a high quality effluent, low in phosphorus and BOD. The lime application initially produced a high quality effluent, but deteriorated rapidly over the draw-down period. (See also W74-08846) (Sandoski-FIRL) W74-08851

#### DESIGN CONSIDERATIONS IN THE IMPLEMENTATION OF ONTARIO'S PHOSPHORUS REMOVAL PROGRAMME,

Ministry of the Environment, Toronto (Ontario). Research Branch. B. I. Boyko, and J. W. G. Rupke.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 34 p, 8 fig, 5 tab, 10 ref.

Descriptors: \*Waste water treatment, \*Phosphorus, \*On-site testing, \*Treatment facilities, \*Chemical precipitation, Coagulation, Activated sludge, Effluents, Anaerobic digestion, Sludge treatment, \*Canada.

Identifiers: \*Phosphorus removal.

The predictive methodology, operational results, problem areas, and design considerations that have resulted from the full scale phosphorus removal studies conducted at waste water treatment facilities ranging in size from 0.05 to 24.0 mgd capacity are discussed. Also, the results of studies involving phosphorus removal through continuous chemical addition to waste stabilization pond are disclosed. The following conclusions are presented: a satisfactory predictive technique was developed that allows a rational selection of prime coagulant to be used for phosphorus removal at a treatment facility; phosphorus removal was readily implemented with minimal capital expenditure; satisfactory effluent quality was attained by the activated sludge process and its modifications when phosphorus removal was practised; increased sludge production was experienced at all systems; and, anaerobic digestion of chemical sludges associated with phosphorus removal was successful with no significant phosphorus release being observed. (See also W74-08846) (Sandoski-FIRL) W74-08852

#### PHOSPHORUS REMOVAL ON SECONDARY EFFLUENTS,

Environmental Protection Service, Ottawa (Ontario). E. E. Shannon.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 16 p, 7 fig, 30 ref.

Descriptors: \*Chemical precipitation, \*Phosphorus compounds, Equipment, Biochemical oxygen demand, Mixing, Flocculation, Hydrogen ion concentration, Filtration, \*Canada, \*Waste water treatment.

Identifiers: \*Phosphorus removal, Clarification.

Phosphorus precipitation by chemical addition to the secondary effluent requires the addition of separate equipment onto the existing facility and reduces the effluent total phosphorus levels in the order of .1 to .5 mg/liter and reduces the BOD to less than 10. Some alternatives for post-precipitation are depicted, with the individual components being flash mixing, flocculation, and clarification, or the three combined in a reactor clarifier, pH adjustment, and filtration. Design aspects of the various stages in post precipitation are discussed. (See also W74-08846) (Sandoski-FIRL) W74-08853

#### SOME PLANT DESIGN CONSIDERATIONS IN PHOSPHORUS REMOVAL FACILITIES,

G. A. Aldworth.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 19 p, 2 fig.

Descriptors: \*Design criteria, \*Phosphorus compounds, \*Chemical treatment, Equipment, Corrosion, Treatment facilities, Lime, Aluminum, Chlorides, Iron, \*Canada, \*Waste water treatment.

Identifiers: \*Phosphorus removal, Feed systems.

Described are areas related to detailed design for phosphorus removal with the following topics explored: effects of encrustation and corrosion; representative chemical feed systems; and, the effect of chemicals on plant elements such as air diffusers, pumps, tanks, and piping. Emphasized are schemes involving the storage and feeding of large amounts of chemicals received in bulk form. A summary of guidelines for the use of lime treatment and alum or ferric chloride treatment in phosphorus removal is included. (See also W74-08846) (Sandoski-FIRL) W74-08854

#### PHOSPHORUS REMOVAL COSTS,

G. Powell, and P. Crawford.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 38 p, 9 fig, 2 tab, 8 ref.

Descriptors: \*Costs, \*Economic efficiency, \*Waste water treatment, Lime, Sludge disposal, Data collections, Water quality control, Effluents, Treatment facilities, Chemical precipitation, \*Canada.

Identifiers: \*Phosphorus removal.

A significant factor to phosphorus removal costs pertaining to waste water plants is the designer's familiarity with the effect of the phosphorus removal chemicals on the treatment processes. Insufficient data are presently available for accurate costs of phosphorus sludge disposal and the effect of lime on the biological treatment at elevated hydrogen ion concentrations. As effluent standards are made more stringent to safeguard waters, treatment costs will increase. Thus, with higher and more sophisticated degrees of treatment, a better understanding of the operation and the economics of the treatment processes involved will result. (See also W74-08846) (Sandoski-FIRL) W74-08855

#### INSTRUMENTATION AND AUTOMATIC CONTROL OF PHOSPHORUS REMOVAL PROCESSES,

Dow Chemical Co., Midland, Mich. Environmental Control Systems.

S. L. Daniels.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 21 p, 7 fig, 1 tab, 17 ref.

Descriptors: \*Waste water treatment, \*Phosphorus, \*Chemical precipitation, \*Flocculation, Instrumentation, \*Control systems, Monitoring, Measurement, \*Canada.

Identifiers: \*Phosphorus removal.

Significant reductions of all phosphorus species present in municipal waste water are technically feasible in existing treatment plants before effluents are discharged into receiving waters. These reductions are accomplished by modifying conventional and flocculation processes. Instrumentation in both coagulation and flocculation processes has been limited to controlling the storage and preparation of chemicals, the metering of chemical additions, and the monitoring of influent and effluent qualities. Comparisons of typical flocculant preparation systems, flocculant addition systems, and coagulant addition systems for five ranges of total plant flow are summarized. (See also W74-08846) (Sandoski-FIRL) W74-08856

#### CHEMICAL HANDLING: THE CHEMICAL FEEDER AND ITS RELATED SYSTEM WHEN APPLIED TO ALUM, FERRIC CHLORIDE, LIME AND POLYMERS,

Control and Metering Ltd., Toronto (Ontario).

T. Fahlenbock.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 30 p, 7 fig, 3 tab.

Descriptors: \*Chemical precipitation, \*Equipment, Measurement, Design criteria, Operation and maintenance, Performance, Alum, Iron, Chlorides, Lime, \*Canada, \*Waste water treatment.

Identifiers: \*Chemical feeder, \*Phosphorus removal.

Various characteristics of the chemical feeder or metering pump including basic design, operation, accuracy, sizing, system components, stages of design development, and performance specifications, are detailed. Also discussed are the maximum and minimum feed rates for the feeder as well as its ability to handle alum, ferric chloride, dry polymers and lime. (See also W74-08846) (Sandoski-FIRL) W74-08857

#### USE OF LIME FOR PHOSPHORUS REMOVAL, Environmental Protection Service, Burlington (Ontario). Waste Water Technology Centre.

B. P. Le Clair, and E. Ladouceur.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 15 p, 6 fig, 3 tab, 7 ref.

Descriptors: \*Lime, \*Design criteria, \*Operation and maintenance, \*Cost comparisons, \*Waste water treatment, Chemical precipitation, \*Canada.

Identifiers: \*Phosphorus removal.

Process design information and operating experience on the use of lime, including the direct use of dry unsalted lime for phosphorus removal, are summarized. Of the three methods demonstrated at full scale, the method involving dry hydrated lime storage in a silo and batch continuous slurry makeup is preferred. Approximately 25 percent chemical cost saving should be realized with the method as well as fewer operating difficulties. (See also W74-08846) (Sandoski-FIRL) W74-08858

#### ACTIVATED SLUDGE CHARACTERIZATION AND SETTLING,

Environmental Protection Service, Ottawa (Ontario).

R. Zaloum.

In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 15 p, 6 fig, 6 ref.

Descriptors: \*Activated sludge, Physical properties, Chemical properties, Biological properties, Investigations, \*Canada, \*Waste water treatment.

Identifiers: \*Sludge characterization, \*Phosphorus removal.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

This study is a portion of a sludge dewatering and reduction project aimed at the characterization of sludges with respect to physical, chemical, and biological properties and the correlation of these properties with various process units. Some of the progress achieved in this area is presented and discussed. The methods presently used for the determination of clarifier areas are evaluated. Typical results are presented. (See also W74-08846) (Sandoski-FIRL)  
W74-08859

**THICKENING AND DEWATERING SLUDGES PRODUCED IN PHOSPHATE REMOVAL.**  
C. H. Knight, R. G. Mondoux, and B. Hambley.  
In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1 (1973). 17 p, 4 fig, 7 ref.

Descriptors: Treatment facilities, Efficiencies, \*Dewatering, \*Sludge treatment, \*Chemical precipitation, Water balance, \*Waste water treatment, \*Canada.  
Identifiers: \*Phosphorus removal, \*Sludge thickening, Treatment methods.

The effect of adding 80 percent phosphate removal facilities on the capacity and efficiency of dewatering processes is examined. Material and water balances and average capacity figures are developed for the various dewatering processes and different chemical additions. No two sludges are alike; bench scale and plant scale tests are desirable to confirm critical design conditions. The various treatment methods studied include gravity thickening, flotation thickening, nozzle discharge disc centrifuge thickening, vacuum filtration, and conveyor type centrifuge dewatering. (See also W74-08846) (Sandoski-FIRL)  
W74-08860

**A CURSORY LOOK AT THE IMPACT OF PHOSPHORUS LADEN SLUDGES ON CONVERSION PROCESSES.**  
R. V. Villiers.  
In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1, (1973). 20 p, 6 tab, 14 ref.

Descriptors: \*Sludge treatment, Heat treatment, \*Incineration, \*Anaerobic digestion, \*Aerobic treatment, \*Chlorination, Lime, Phosphorus, Temperature, Hydrogen ion concentration, Mixing time, Organic matter, Operations, \*Canada, \*Waste water treatment.  
Identifiers: \*Phosphorus removal, Sludge characteristics, Loading.

Conversion processes alter sludge constituents to make them inoffensive, nonviable, or unextractable to permit reuse or return of the sludge to the environment. Such processes include heat treatment, incineration, anaerobic digestion, aerobic digestion, chlorination, or lime treatment. All processes are temperature and pH dependent; sensitive to change in loading, time, and mixing; sensitive to change in air and food supply; and concerned with organic matter destruction or stabilization. Cause-effect relationships between the process and phosphorus-sludge are predicted by relating the following three categorizations to the various conversion processes. The categorizations are: changes in sludge characteristics; process operating parameters; and, changes in sludge components during conversion. (See also W74-08846) (Sandoski-FIRL)  
W74-08861

**LAND APPLICATION OF PROCESSED ORGANIC WASTES.**  
Ministry of the Environment, Toronto (Ontario). Waste Management Branch.  
G. M. Wood.  
In: Phosphorus Removal Design Seminar, Conference Proceedings No. 1, (1973). 29 p, 2 tab.

Descriptors: \*Regulation, \*Governments, \*Organic wastes, \*Waste disposal, \*Waste treatment, \*Soil disposal fields, Soil engineering, Sites, \*Canada.  
Identifiers: \*Phosphorus removal.

Under the authority of the recent amendments to Regulation 824 of the Revised Regulations of Ontario, 1970, the Ministry of the Environment is undertaking the certification of haulers, organic waste management systems, and organic soil conditioning sites for the disposal of processed organic waste. According to the amendment, 'No person shall use, operate, establish, alter, enlarge, or extend a waste management system or a waste disposal site' unless governmental approval has been received. Standards for the location, maintenance, and operation of an organic soil conditioning site which include such topics as site location, land characteristics, site management, and sludge application rates are discussed. (See also W74-08846) (Sandoski-FIRL)  
W74-08862

**THE BALANCE BETWEEN WASTE TREATMENT AND WASTE DISCHARGE IN THE U.S., 1957-2000.**  
Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.  
I. G. Wallis.  
Journal of the Water Pollution Control Federation, Vol 46, No 3, p 438-457, March, 1974. 3 fig, 11 tab, 54 ref.

Descriptors: \*Waste water treatment, \*Water quality, \*Phosphorus, Agricultural wastes, Domestic wastes, Human population, Costs, Effluents, \*Waste treatment, Sewage systems, Oxygen demand, \*Waste disposal.

If overall river quality level is to improve, treatment efficiency must increase even faster than the rate of increase of waste generation. The treatment level required to maintain a constant level of waste discharge is estimated for years 1970 to 2000. Two ubiquitous wastes are phosphorus wastes-generated primarily from domestic and agricultural sources, and oxygen demanding wastes-produced from industrial sources. Factors for increase in phosphorus wastes were population increase, growth in detergent use, expansion of the sewage system, and increased rural runoff of phosphoric fertilizers. High costs of waste treatment include changing raw material input, production process, recovering materials from the effluent, and transforming effluents into a useful by-product. The technological advances necessary to reduce waste discharge and hence improve water quality, a feasible but costly process are discussed. (Prague-FIRL)  
W74-08868

**EVALUATION OF A ROTATING DISK WASTE-WATER TREATMENT PLANT.**  
Autotrol Corp., Milwaukee, Wis. Bio-Systems Div.  
R. L. Antonie, D. L. Kluge, and J. H. Mielke.  
Journal of the Water Pollution Control Federation, Vol 46, No 3, p 498-511, March, 1974. 11 fig, 4 tab, 5 ref.

Descriptors: \*Waste water treatment, \*Biochemical oxygen demand, \*Nitrification, \*Organic loading, \*Suspended solids, Hydraulics, Sludge treatment, Treatment facilities.  
Identifiers: Waste water treatment plant, Hydraulic loading, Treatment plant construction, Sludge Solids.

After nine out of twelve months of an evaluation period, a 0.5 mgd (1.9-mil liter/day) rotating disk municipal waste water treatment plant has been highly successful. Capability is shown of achieving high degrees of biochemical oxygen demand and suspended solid removal and nitrification. The variables investigated included rotational disk

velocity, hydraulic loading, and exposure to different climatic conditions. The plant exhibited stable operation under conditions of fluctuating hydraulic and organic loading and waste water temperature. High density of sludge solids indicates significant potential savings in treatment plant construction and operating costs. (Prague-FIRL)  
W74-08869

**STARTUP AND OPERATION OF THE ROCKVILLE WATER TREATMENT PLANT.**  
Rockville Water and Aqueduct Co., Conn.  
For primary bibliographic entry see Field 5F.  
W74-08872

**WATER UTILITIES OPERATOR TRAINING: A WORTHY INVESTMENT.**  
Texas Water Quality Board, Austin. Central Operations Div.  
H. D. Jobs.  
Water and Sewage Works, Vol 121, No 4, p 58-59, April, 1974.

Descriptors: Training, \*Operations, \*Evaluation, Personnel, \*Texas, Water quality, Investment, Water pollution control, \*Treatment facilities.

A study made for the Environmental Protection Agency on a water utilities operator training program in Texas is discussed. Methodology of the study was to examine treatment plant operations as they existed before employee training and to examine results after training. The effectiveness evaluation study document states in its conclusion that for every dollar invested in training, the equivalent of an additional \$91 investment in capital plant was activated in terms of improved performance. The degree of reduction of BOD, total suspended solids, and levels of overall improvements following training indicated conclusively that for these plants the value of return on training was high in terms of both dollars invested and cleanliness of water treatment. (Merritt-FIRL)  
W74-08879

**FLOC BLANKET CLARIFICATION.**  
Effluent and Water Treatment Journal, Vol 14, No 1, p 51 January, 1974.

Descriptors: \*Waste water treatment, \*Chemical properties, \*Hydraulic properties, Water purification, Equipment, Flocculation, Iron compounds, Rivers.  
Identifiers: \*Floc blanket clarifiers, \*Czechoslovakia.

Laboratory experiments at the Technical College at Zilina and full scale tests at Brno in Czechoslovakia have been investigating the floc blanket clarifiers in terms of hydraulic and chemical characteristics. In the laboratory a 300 mm diameter by 3 m high column received chemically dosed water entering tangentially at the base. At upflow velocities of 1.2 mm/s floc volume concentrations were uniform with depth at about 20%, but solids fraction values increased with depth, usually increasing by about 20% from top to bottom. The actual values of solids fraction depended on the chemicals which had been added. River water was utilized at Brno and when the water temperature exceeded 10°C the upflow rate was 1.3 mm/s, but during winter the output fell to about 0.8 mm/s. Previously, output had been sustained by 25 mg/liter bentonite, but it was learned that 0.3 mg/liter starch produced the required results. Performance was assessed in terms of residual iron in the clarified water. The iron could be measured against performance characteristics; the flocculation product was the most sensitive parameter with an optimal value of 3000. (Merritt-FIRL)  
W74-08884

**TURBIDITY CONTROL BY AUTOMATIC DIVERSION,**

Treatment and Supply, Aspen, Colo.  
J. J. Markalanus.  
Water and Sewage Works, Vol 121, No 2, p 44-45, February, 1974.

Descriptors: \*Waste water treatment, \*Diversion structures, \*Turbidity, \*Automatic control, \*Chemical treatment, Treatment facilities, Water purification, Iron compounds, Industrial wastes, \*Colorado.  
Identifiers: \*Aspen(Colo), Turbidimeters.

The automatic raw water diversion system and automatic chemical dosage system for turbidity control at the Aspen, Colorado treatment plant are described. At times the water supply for Aspen (Castle Creek) becomes highly turbid and high in iron content. To assure that this water does not enter the city's reservoir, a system was devised to turn off the raw water diversion and restore the raw water pipeline to service after the water cleared up. An intake diversion dam on Castle Creek conducts the flow through a pipe line to a structure where a 30 in diameter butterfly valve is located. When the valve is closed, the flow passes over a weir and returns to the creek. When the valve is open, the water flows on through the pipe line to the water treatment plant some 2 miles away. This unit has an automatic alarm system that enables the operator to maintain a chemical dosage for a limited range of turbidities and also increases the length of filter runs. The raw water storage reservoir does not silt up as quickly and the net water production of the plant is greater. (Merritt-FIRL)  
W74-08889

**NEW ARIZONA WASTEWATER PLANT TO ALLEVIATE PROBLEMS,**

Collins (John S.), and Associates, Tucson, Ariz.  
E. Roll.  
Water and Sewage Works, Vol 121, No 4, p 60, April, 1974.

Descriptors: \*Reclaimed water, \*Waste water treatment, \*Treatment facilities, \*Arizona, Equipment, Automation, Automatic control, Activated sludge, Biological treatment, Flow, Suspended solids, Biological oxygen demand, Costs, Measurement.  
Identifiers: \*Tucson(Ariz).

The Tucson, Arizona \$1.5 million waste water reclamation plant now under construction is described. The new, nearly constant flow (1,417 gpm) plant will have automatic sampling equipment, electronic metering and control, and will automatically record pH and chlorine residual levels. It will utilize automatic air injection and solids control for the aeration basin. The control building also has a small but efficient facility for on site laboratory analysis and an equipment maintenance shop. The activated sludge biological process will be used in handling an average flow of 1.5 mg/d and a peak of 2.0 mg/d. Influent to the reclamation system has 180 mg/liter of suspended solids and 200 mg/liter of biological oxygen demand. The cost of the operation is estimated at \$84,293 per year of \$154 per million gallons of reclaimed water produced. (Merritt-FIRL)  
W74-08890

**CHLORINE RESIDUALS IN TREATED EFFLUENTS,**

Illinois Univ., Urbana. Dept. of Civil Engineering.  
For primary bibliographic entry see Field 5C.  
W74-08891

**CORROSION-RESISTANT PIPE AT WALT DISNEY WORLD.**

For primary bibliographic entry see Field 8G.  
W74-08892

**APPARATUS FOR AND PROCESS OF TREATING LIQUIDS WITH A GAS,**

E. T. Armstrong.  
U.S. Patent 3,805,481. Official Gazette of the U.S. Patent Office, Vol 921, No 4, p 1359, April 23, 1974. 1 fig.

Descriptors: \*Gases, \*Patents, \*Liquids, \*Mixing, Disinfection, Separation techniques, Equipment, Flow, Oxygen, Ozone, Flow, \*Waste water treatment.  
Identifiers: Sterilization, Bacterial reduction.

A gas-liquid mixing system for selective bacterial reduction, generalized disinfection sterilization or other gas treatment of the liquid is described. The system utilizes essential gravitational head and/or pumps in conjunction with a process flow line which may operate under a hydraulic pressure gradient. It has an inlet at one end for receiving the untreated liquid and an outlet at its opposite end, one or more local areas of high momentum exchange, and one or more injectors for the introduction of a gas into the process line. The injectors are located so as to introduce the gas into the liquid downstream from the areas of high momentum exchange where the static pressure is at least partially regained. The gas may consist of air, oxygen, or an oxygen ozone mixture, either alone or mixed with a carrier gas. (Merritt-FIRL)  
W74-08896

**RADIOACTIVE WASTE TREATMENT SYSTEM,**

Nuclear Waste Systems Co., Campbell, Calif. (Assignee)  
J. Mertens.  
U.S. Patent 3,805,959. Official Gazette of the U.S. Patent Office, Vol 921, No 4, p 1483, April 23, 1974.

Descriptors: \*Waste water treatment, \*Patents, \*Radioactive wastes, Solid wastes, Sludges, Resins, Storage tanks, Separation techniques, Percolation, Waste disposal.

A radioactive waste treatment system is described for solid radioactive process waste from nuclear reactor power plants. The wastes consist of filter sludges and demineralized resins or ion exchange resins. The wastes are moved to large tanks where they are collected. The backwash water and floor drain water wastes are percolated through settled solids by gravity. In doing so, the wastes are prefiltered and predemineralized. The waste waters are then polished in the water treatment system and returned to a condensate storage tank. (Merritt-FIRL)  
W74-08897

**SEWAGE AND WATER TREATMENT WITH MODIFIED QUATERNARY SALTS OF VINYL PYRIDINE COPOLYMERS,**

Philips Petroleum Co., Bartlesville, Okla. (Assignee)  
R. C. Doss, and J. W. Cleary.  
U.S. Patent 3,806,450. Official Gazette of the U.S. Patent Office, Vol 921, No 4, p 1604, April 23, 1974.

Descriptors: \*Patents, \*Sewage treatment, \*Waste water treatment, \*Salts, Coagulation, Filtration, Flocculation.  
Identifiers: \*Vinylpyridine, \*Quaternary salts.

A sewage and water treatment system is described in which the sewage and water are chemically conditioned with modified quaternary salts of vinylpyridine copolymers. Coagulation, flocculation, and filtration in sewage and water treatment processes are significantly improved by the use of the salts. (Merritt-FIRL)  
W74-08899

**AUTOMATIC VALVES, PARTICULARLY FOR USE WITH FILTERS,**

Engineering Components Ltd., Liverpool (England). (Assignee)  
For primary bibliographic entry see Field 8C.  
W74-08900

**DEVICE FOR CONDUCTING WASTE LIQUID FROM A RECEPTACLE TO A PNEUMATIC LIQUID DISPOSAL SYSTEM,**

Aktiebolaget Electrolux, Stockholm (Sweden). (assignee)  
For primary bibliographic entry see Field 8A.  
W74-08901

**METHOD AND APPARATUS FOR REMOVING SOLIDS,**

FMC Corp., San Jose, Calif. (assignee)  
H. L. Pentz, C. Parkhani, and F. Majeron.  
U.S. Patent 3,807,560. Official Gazette of the U.S. Patent Office, Vol 921, No 5, p 1908-1909, April 30, 1974. 1 fig.

Descriptors: \*Separation techniques, \*Patents, Equipment, \*Bottom sediments, Settling basins, \*Sludge treatment, \*Waste water treatment.

A method and apparatus for removing a varying depth layer of settled solids from the bottom of a sedimentation tank is described. The apparatus includes a plurality of spaced eduction means supported on a bridge that is movable transversely between spaced inlets and outlets for the tank to remove settled solids from associated zones in the tank bottom. The apparatus provides a range of flow capacity between a minimum and maximum for each zone. The flow of sludge can be adjusted to remove all deposited solids from each zone during each pass of the bridge. A sensing mechanism maintains a substantially uniform solids concentration in the sludge being removed. (Merritt-FIRL)  
W74-08902

**FORT WORTH WATER SUPPLY AND TREATMENT PLANT DEDICATED.**

Water and Sewage Works, Vol 12, No 4, p 46-47, 63, April, 1974. 5 figs.

Descriptors: \*Design data, \*Pumping station, \*Treatment facilities, Pipelines, Reservoirs, Construction, \*Waste water treatment, Chemical treatment, Water analysis, Taste, Odor, Sedimentation, Filtration, Filters, Pumps, Flocculation, \*Texas.  
Identifiers: \*Fort Worth(Tex).

The dedication and design of the Cedar Creek Lake Pump Station and the Rolling Hill Water Treatment Plant of Fort Worth, Texas are described. The Cedar Creek project consists of the Cedar Creek Reservoir with a capacity of 678,000 acre-ft, the dam being about 85 mi southeast of Fort Worth; an intake pump station at the reservoir; a 72 in pipe line with appurtenant pump stations, 68.2 mi in length from the reservoir intake to a balancing reservoir at the end of the 72 in section of pipe line; an 84 in pipe line, 6.1 mi in length from the balancing reservoir to the site of the treatment plant; and the balancing reservoir with a capacity of 150 mil gal. Designed to handle 80 mgd, the \$8.7 million Rolling Hills plant will be able to treat 100 mgd when transmission facilities permit. Expansion to 160 mgd will not require added chemical facilities, administrative or laboratory buildings, or high service pump stations. The 194 acre sites will allow expansion to 320 mgd. Plant design permits ultimate computer control with data logging. The water is treated for turbidity, taste, and odor control. Following chemical application proportional to flow, the water is mixed, coagulated, settled, filtered and stored for delivery. (Merritt-FIRL)  
W74-08904

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

**DESIGN OF FILTRATION PLANT FOR ROCKVILLE, CONNECTICUT,**  
Metcalf and Eddy, Inc., Boston, Mass.  
For primary bibliographic entry see Field 5F.  
W74-08910

**TURBIDIMETERS MONITOR DUBAI FLOOD WATER.**  
For primary bibliographic entry see Field 7B.  
W74-08913

**METHOD FOR DRYING SLUDGE AND INCINERATING ODOR BODIES,**  
Atomic Energy Commission, Washington, D.C. (assignee)  
F. R. Keller.  
U.S. Patent 3,805,715. Official Gazette of the U.S. Patent Office, Vol 921, No 4, p 1421, April 23, 1974.

Descriptors: \*Drying, \*Patents, \*Sewage sludge, \*Odor, Control, \*Incineration, Gases, Turbines, Equipment, Waste water treatment.  
Identifiers: \*Fluidized bed.

A process for drying sewage sludge and eliminating its odors is described. The sludge is dried in a fluidized bed dryer while the odors are eliminated by incinerating them in a fluidized bed incinerator. The hot exit gases from the incinerator are employed to preheat both the sewage sludge feed and the fluidizing air stream for the fluidized bed dryer. The dryer contains a heat exchanger submerged in the fluidized bed which provides the heat for drying from the low pressure exhaust steam exiting from an extraction turbine. The condensate and exhaust from the dryer heat exchanger are recycled to the incinerator heat exchanger for generation of high pressure steam. The output of the extraction turbine is used to drive air blowers for the two fluidized beds. The fluidized bed incinerator is fluidized with the stream of off gases and odor bodies from the fluidized bed dryer, the fuel value of the off gases and odor is effectively used in the incinerator where heat is generated by fuel combustion. (Merritt-FIRL)  
W74-08915

**SEWAGE FLOW CONTROL SYSTEM,**  
S. F. Smith.  
U.S. Patent 3,805,817. Official Gazette of the U.S. Patent Office, Vol 921, No 4, p 1446-1447, April 23, 1974. 2 fig.

Descriptors: \*Patents, \*Sewage, \*Flow control, Pipes, Stabilization, Flow rates, Groundwater, Waste water treatment, Pollution abatement, \*Water pollution control.

A sewage flow control system is described for a sewage piping complex. Flow stabilizing stations are mounted in a series of section, each including means for constricting and means for accelerating flow to maintain selected pressures and flow rates in the controlled sections. This process obtains maximum use of the cubical volume of the piping complex to maintain the piping full of fluid to provide overall even flows of sewage during both normal peak and low volume flows and sufficient internal piping pressure to inhibit ground water influx. (Merritt-FIRL)  
W74-08916

**RELATIONSHIP BETWEEN BOD REMOVAL AND LAS DETERGENT REMOVAL IN WASTE-WATER TREATMENT SYSTEMS,**  
Puerto Rico Univ., Mayaguez. Dept. of Civil Engineering.  
N.-H. Tang.  
Available from the National Technical Information Service as PB-232 997; \$3.75 in paper copy, \$1.45 in microfiche. Puerto Rico Water Resources Research Institute, Mayaguez, Completion Re-

port, May 1974. 57 p, 16 fig, 15 tab, 6 ref. OWRR A-035-PR(1).

Descriptors: \*Waste water treatment, \*Biochemical oxygen demand, \*Detergents, \*Linear alkylate sulfonates, Domestic wastes, \*Biological treatment, Performance efficiencies, Activated sludge, Trickling filters, Chemical oxygen demand.  
Identifiers: \*BOD removal, Total organic carbon.

Traditionally, biological process efficiency is measured by its BOD removal. However, a period of 5 days is required to determine the BOD in wastewater. This is too long a period of time for process control. If the process is controlled by COD removal, much shorter time will be needed for determination. The complexity of today's sewage causes the ratio of biodegradable organics to non-biodegradable organics in wastewater to change frequently; this changing nature, in turn, prevents meaningful uses of COD information. Information of TOC has the same problem as that of COD. In detergent, LAS (Linear Alkylate Sulfonate) is a basic organic element which is readily degraded in municipal biological processes. It is one of the many biodegradable organic compounds in wastewater. The fact that LAS can be rapidly determined within 30 minutes makes its use advantageous for process control. The relationship between BOD removal and LAS removal in biological processes, was studied. The results indicate that BOD removal and LAS removal in both activated sludge and trickling filter processes are significantly correlated. It is very likely that the % LAS removal of a biological process can be used to predict the % BOD removal of the same process.  
W74-08939

**EVALUATING WATER REUSE ALTERNATIVES IN WATER RESOURCES PLANNING,**  
Utah State Univ., Logan. Center for Water Resources Research.  
A. B. Bishop, W. J. Grenney, R. Narayanan, and S. L. Klemetson.  
Available from the National Technical Information Service as PB-232 996; \$4.75 in paper copy, \$1.45 in microfiche. Utah Water Research Laboratory, Publication No PRWG123-1, January 1974. 137 p, 42 fig, 28 tab, 39 ref, 8 append. OWRR B-075-UTAH(1). 14-31-0001-3941.

Descriptors: \*Water reuse, \*Waste water treatment, \*Water supply, \*Systems analysis, Linear programming, Optimization, Water costs, \*Utah, Evaluation, \*Alternative planning, Model studies.  
Identifiers: Jordan River Basin(Utah), Salt Lake City(Utah).

Water reuse is a recognized option for augmenting water supplies to provide for expanded water needs. A methodology is developed for examining optimal strategies for water reuse within the context of the total water resources system, including both the provision of water supplies for various uses and management of wastewaters. A model of the water resources system is formulated as a 'transportation' or 'transshipment' problem in linear programming depicting the possible sources of supply, including effluent sources available for reuse, which can be used to satisfy the requirements of various water users. The optimizing objective in the model is to minimize the cost of meeting water supply requirements and of wastewater treatment to satisfy water quality standards. The Lower Jordan River Basin, which encompasses the Salt Lake City, Utah, metropolitan area, is used as a case study for applying and testing the model. Optimal allocations were obtained for low, middle, and high forecasts of future water requirements roughly corresponding to a fifty-year time horizon. Four alternatives for regional wastewater treatment were also analyzed considering possibilities for reuse. Assessment capabilities of the model include examining redistribution of supplies, time-staging of supplies and related treat-

ment facilities, and analyzing sensitivity of allocations to changes in costs.  
W74-08940

**INDUSTRIAL WATER SOFTENER WASTE BRINE RECLAMATION,**  
Culligan, International Co., Northbrook, Ill.  
J. Burton, and E. Kreusch.  
Copy Available from GPO Sup Doc as EPI 23:660/2-74-007, \$1.95; microfiche from NTIS as PB-233 132, \$1.45. Environmental Protection Agency, Technology Series Report EPA-660/2-74-007, February 1974. 158 p, 25 fig, 19 tab, 2 ref. EPA Project 12120 GLE.

Descriptors: \*Water reuse, \*Water softening, \*Chemical precipitation, \*Brines, Hardness(Water), Water pollution treatment lime, \*Waste disposal, Brine disposal, Industrial water, Capital costs, Operating costs.  
Identifiers: \*Regenerant reuse, Lime soda softening, Regenerant disposal.

There are two alternatives for discharge of water softener regenerant brines to receiving streams: (1) truck to approved dumping site; (2) reclaim for reuse. Brine reuse has been studied at a central regeneration facility for portable water softeners. Reclamation used modified lime-soda softening for the waste brine to produce an acceptable regenerant brine. Regenerant wastes were reduced by 89% to produce an environmentally acceptable sludge. The process is feasible technically, marginal economically. The added costs for lime and soda ash are less than is the value of salt and water reclaimed by their use. That is, the process is cheaper chemically; however, equipment and labor costs negate this savings. Depreciation and operating costs were high at the test location: total costs favor trucking wastes to an approved dumping site. Capital and operating costs may be reduced under a new project following the report's recommendations. (EPA)  
W74-08941

**A PLANNED MAINTENANCE MANAGEMENT SYSTEM FOR MUNICIPAL WASTEWATER TREATMENT PLANTS,**  
EnviroPlan, Inc., College Park, Md. Fairfax County, Va.  
D. H. Sargent, and D. A. Rudich.  
Copy Available from GPO Sup Doc as EPI 23:600/2-73-004, \$1.55; microfiche from NTIS as PB-233 111, \$1.45. Environmental Protection Agency, Technology Series Report EPA-600/2-73-004, November 1973. 111 p, 31 fig, 16 tab, 20 ref. EPA Project 11010 GWI.

Descriptors: \*Waste water treatment, Maintenance, \*Management, \*Scheduling, \*Manpower, \*Operation and maintenance, \*Maintenance costs, Equipment, Mechanical equipment, Hydraulic equipment, Electrical equipment, Instrumentation, Warning systems, Control systems, \*Treatment facilities.  
Identifiers: Planned maintenance, Maintenance management, Preventive maintenance, Corrective maintenance, Maintenance procedures.

A Planned Maintenance Management System (PMMS) has been developed and successfully demonstrated at the 18-MGD Lower Potomac Plant of Fairfax County, Va., establishing a model maintenance management program for wastewater treatment plants throughout the United States. This PMMS provides for the specific maintenance needs of each item of plant equipment and reduces the maintenance of complex equipment to simple procedures. For each procedure the PMMS details the methods, materials, tools and personnel required; schedules the task; and provides for data recording and feedback. The success of this PMMS during the 12-month demonstration phase was measured by a steady downward trend in the malfunction of mechanical equipment. Incipient failures were detected in many cases and cor-

rective action was taken to avoid breakdowns. This report describes the PMMS in technical detail; discusses the installation of the PMMS, including acceptance by the mechanics and coordination with plant operations; and outlines the application of the PMMS to other wastewater systems. (EPA)

W74-08944

**SULFURIC ACID AND FERROUS SULFATE RECOVERY FROM WASTE PICKLE LIQUOR,** Fitzsimons Steel Co., Youngstown, Ohio. J. K. Seyler, W. E. Thornton, and M. K. Householder.

Copy Available from GPO Sup Doc as EPL-23-660/2-73-032, \$1.20; microfiche from NTIS as PB-233 112, \$1.45. Environmental Protection Agency, Technology Series Report, EPA-660/2-73-032, January 1974. 71 p, 16 fig, 22 tab, 8 ref. EPA Project 12010 FNM.

Descriptors: \*Waste water treatment, \*Industrial wastes, Sulfates, \*Crystallization, Centrifugation, Chemical precipitation, Capital costs, Operating costs.

Identifiers: Sulfuric acid, \*Spent pickle liquor, Ferrous sulfate heptahydrate, \*Acid recovery, Chemical recovery.

This report describes the investigation of the process variables of a facility for the treatment of spent sulfuric acid pickle liquor. The process is based on the vacuum crystallization technique developed by Keram Chemie-Lurgi of Germany. It recovers ferrous sulfate heptahydrate as a nearly dry solid by-product and recovers the unreacted acid for recycle to the pickling tank thus eliminating the discharge of spent pickle liquor and rinse water. The full scale facility achieved acid recoveries equivalent to 21.2 tons/day of 12% sulfuric acid for recycle and an average of 115 lbs/hour of 99.56% FeSO<sub>4</sub>·7H<sub>2</sub>O by-product. Capital costs were \$191,710 or \$19,739/year based on a fifteen year life at 6% interest. Net operating costs were \$42,320/year including a \$21,400/year benefit from acid recovery. (No credit of \$2,300/year of ferrous sulfate heptahydrate was included due to the nationwide excess production over market absorbing ability.) The total costs were \$62,059/year, \$1.75/ton of steel pickled, 0.614 cents/\$ total sales, or \$12.93/cubic meter of wastes treated. (EPA)

W74-08945

**RADIATION HAZARDS FROM THE MISUSE OF URANIUM MILL TAILINGS,** Brandeis Univ., Waltham, Mass. Dept. of Biochemistry.

For primary bibliographic entry see Field 5C. W74-08951

**TRANSURANIC SOLID WASTE MANAGEMENT RESEARCH PROGRAMS -- QUARTERLY REPORT, JULY-SEPTEMBER 1973.**

Los Alamos Scientific Lab., N. Mex. Available NTIS, Springfield, Va. as Rept No LA-5512-PR, \$4.00/copy, \$1.45/microfiche. Report LA-5512-PR, February 1974. 22 p, 4 fig, 4 tab, 1 append.

Descriptors: \*Radioactive waste disposal, \*Underground waste disposal, \*Waste treatment, \*Water pollution, \*Water pollution sources, Soil contamination, Research and development, Research facilities, Waste storage, Safety, Assessment, Model studies, Geology, Hydrology, Meteorology, Groundwater, Sites.

Identifiers: \*Burial grounds.

Progress during the period of July-September 1973 is reviewed for three transuranic solid waste management research programs funded by the AEC Division of Waste Management and Transportation. The three programs include transuranic solid waste management research and development, the contaminated waste treatment develop-

ment facility, and the burial grounds evaluation. The interim storage criteria are now ready to be issued for general review. Experiments in radiolysis and container corrosion have been reorganized and expanded to provide information for optimization of interim storage, while waste sorting experiments have begun to determine more accurately the character of wastes being produced at LASL. Several task forces have been organized for the waste treatment facility to evaluate incinerators and determine a satisfactory operational size for the facility. Work has begun on developing a model for the risk analysis of radioactive burial grounds. A questionnaire has been developed to obtain the necessary information for the analysis. (Houser-ORNL)

W74-08963

**QUARTERLY PROGRESS REPORT -- RESEARCH AND DEVELOPMENT ACTIVITIES WASTE FIXATION PROGRAM -- OCTOBER THROUGH DECEMBER 1973.**

Battelle-Pacific Northwest Lab., Richland, Wash. Nuclear Waste Technology Dept. Available from NTIS, Springfield, Va. as Rept No BNWL-1809, \$5.45 per copy, \$1.45 microfiche. Report No BNWL-1809, January 1974. 90 p, A.M. Platt, Compiler, 29 fig, 12 tab.

Descriptors: \*Radioactive waste disposal, \*Waste treatment, \*Waste storage, \*Research and development, Waste water(Pollution), Water pollution sources, Leaching, Ion transport, Transporation.

Identifiers: \*Waste solidification, \*Spray solidification, \*Fluidized bed process, Vitrification, Calcination, Fixation, Vaporization.

Progress is reported in research and development activities in the field of radioactive waste fixation. In the area of development of spray calciner and incooler melter, the major considerations were melt agitation, filter differential pressure, and quench scrubbing of the off-gas. Operating parameters and results of development of spray solidification runs are given. Ceramic refractories are being tested in a high temperature waste glass to determine their compatibility for use in a ceramic-lined waste glass melter. Cost comparisons are made for improved heat transfer in radioactive waste canisters. Three oxide systems were examined to note effects of composition on leachability. Waste vaporization studies are made to investigate the behavior of fission product containing wastes. Attention is being given to helium incorporated in the pores of high level waste glasses which may possibly cause stresses similar to those of a small pressure vessel. Analysis of gas samples inside the canisters after storage showed helium and hydrogen below detectable limits. Some alternative waste fixation schemes are being studied. (Houser-ORNL)

W74-08965

**THE ENDOTHERMIC PROCESS-APPLICATION TO IMMOBILIZATION OF HANFORD IN-TANK SOLIDIFIED WASTE,**

Atlantic Richfield Hanford Co., Richland, Wash. Chemical Processing Div. M. J. Kupfer, and W. W. Schulz.

Available from NTIS, Springfield, Va. as Rept No ARH-2800, \$4.00/copy, \$1.45/microfiche. Report No ARH-2800, July 1973. 31 p, 3 fig, 7 tab, 14 ref.

Descriptors: \*Radioactive waste disposal, \*Waste storage, \*Waste treatment, \*Leaching, \*Soil water, Soil contamination, Penetration, Permeability, Porosity, Movement, Cesium, Strontium, Heat, Absorption, \*Washington.

Identifiers: Vitrification, Waste burial, Endothermic, Richland(Wash).

Conversion of high-level solid radioactive waste to a nonleachable silicate glass is accomplished in the Endothermic process by simple melting of a mixture of the waste with crushed basalt. Dense (2.5 g

cm<sup>3</sup>) green-black glasses are obtained by melting mixtures containing 30 to 40 wt% Hanford In-Tank Solidified (ITS) waste, 50 to 70 wt% basalt, and 0 to 10 wt% B<sub>2</sub>O<sub>3</sub>. Addition of B<sub>2</sub>O<sub>3</sub> to the process charge is desirable to lower its melting range from about 1100-1150°C to 1000-1050°C. Leach rates of these glasses (calculated from the sum of the concentrations of Fe, Na, Ca, Si, Mg, Al, Sr, and Cs in the leach liquor) in water at 25°C range from 10(-7) to 10(-5) g/cm sq day. The leach rate, based on Cs-137, of a typical Endothermic process glass made from actual ITS waste is 3.0 x 10(-8) g/cm sq day. This leach rate corresponds to removal of 2.1 x 10(-14) g Cs-137 per day from a square centimeter of glass containing 57 micro-Ci Cs-137 per gram. Judging from initial tests, the Endothermic process is a very promising scheme to increase immobilization of the ITS waste. (Houser-ORNL)

W74-08968

**ORGANIC AND COLOR REMOVAL FROM WATER SUPPLIES BY SYNTHETIC RESINOUS ADSORBENTS,**

Alaska Univ., College. Environmental Quality Engineering and Civil Engineering.

T. Tilsforth.

Available from the National Technical Information Service as PB-233 068, \$3.75 in paper copy, \$1.45 in microfiche. Alaska Institute of Water Resources, Fairbanks, Report No IWR-50, January 1974. 53 p, 16 fig, 2 tab, 29 ref. OWRR A-034-ALAS(1).

Descriptors: \*Resins, Ion exchange, \*Adsorption, Absorption, \*Color, Activated carbon, Aesthetics, Filtration, \*Waste water treatment, \*Water treatment, Alaska, Water supply, \*Organic matter.

Identifiers: Synthetic resinous adsorbents.

An experimental study was conducted to evaluate the effectiveness of synthetic resinous adsorbents for removing color and organics from water supplies. Four different resins were tested with water from three individual sources. The results show that synthetic resinous adsorbents were effective in removing color and organics. The effectiveness of the resins was dependent on their individual characteristics. In general, the resins performed best for moderate concentrations of color and organics. Relatively good color removal was achieved on the sewage treatment plant effluent. Some difficulty was encountered in treating the waters so that they would meet the color requirements for U.S.P.H.S. drinking water standards. The use of synthetic resinous adsorbents appears to hold promise for treatment of relatively small water supplies containing color and organics. The economics of such systems needs further evaluation.

W74-09050

**APPLICATION OF REVERSE OSMOSIS TECHNOLOGY TO HAWAIIAN LOW QUALITY WATERS,**

Hawaii Univ., Honolulu. Water Resources Research Center.

B.-J. Chang, R. H. F. Young, and J. C. S. Chou. Available from the National Technical Information Service as PB-233 130, \$3.75 in paper copy, \$1.45 in microfiche. Technical Report No 73, November 1973. 54 p, 17 fig, 17 tab, 29 ref. OWRR A-036-HI(1). 14-31-0001-3811.

Descriptors: \*Hawaii, \*Waste water treatment, Treatment facilities, \*Reverse osmosis, Groundwater, Water quality, \*Pilot plants, \*Desalination, Brackish water.

Identifiers: \*Oahu(H.I.).

A study of the application of reverse osmosis technology to the treatment of Hawaiian low quality waters was conducted. The purpose was to investigate the technical and economical feasibility of utilizing reverse osmosis technology to renovate waste waters after varying degrees of

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

conventional treatment, and to desalt Hawaiian brackish groundwater from both basaltic and reef limestone aquifers. The experimental investigation of the technical feasibility of renovating waste water and desalting brackish groundwater was conducted with a small reverse osmosis pilot unit at four test sites on the island of Oahu. The operation of the reverse osmosis pilot unit in processing waste waters suffered from the problem of performance decline. However, the pilot unit's operation with brackish groundwater yielded promising results. In general, high rejections of total dissolved solids, refractory organics, nutrients, bacteria, and virus were accomplished by the unit. Two waste water reclamation schemes incorporating the reverse osmosis process were considered possible in Hawaii. Treatment expenditures of the two schemes were estimated at 97.8 cents and 103.2 cents per 1000 gallons of treated waste water. Based on a cost model developed for estimating desalting costs by reverse osmosis plants with spiral wound modules, product water costs in Hawaii were estimated at 83.7 cents, 63.4 cents, and 49.7 cents per 1000 gallons for 1, 10, and 50 mgd plants, respectively.

W74-09052

#### A PORTABLE DEVICE FOR MEASURING WASTEWATER FLOW IN SEWERS,

Hittman Associates, Inc., Columbia, Md.  
M. A. Nawrocki.  
Copy Available from GPO Sup Doc as EPI-23-600/2-73-002, \$1.00; microfiche from NTIS as PB-233 142 \$1.45. Environmental Protection Agency, Technology Series Report, EPA-660/2-73-002, January 1974. 53p, 19 fig, 5 tab, 8 ref. EPA Project 11024 EVF Contract 14-12-099.

Descriptors: \*Flow Measurement, \*Sewers, Development, Gages, \*Fabricated Instrumentation, \*Design criteria, Measurement, Pipes, \*Waste water (Pollution).  
Identifiers: \*Capacitance, \*Heat pulse velocity, Prototype Development.

A research and development program to develop a portable device which is capable of measuring wastewater flow in sewers was undertaken. This work consisted of an investigation of the theoretical approach to be used, laboratory investigations and experiments to develop design criteria, design and fabrication of two prototype units, and field testing and evaluation of these units. Measurement of the cross-sectional area of flow was done by the use of capacitor plates to sense the change in water level in the sewer pipe. The method selected to measure the velocity of the flow involved the timing of a heat pulse as it traveled down the pipe. Theoretical evaluations and laboratory experiments were performed to prove the mode of operation of the proposed gage. Two prototype gages were fabricated. The overall accuracy of the final prototype was plus or minus 15 percent. The accuracy of the separate cross-sectional area measurements was within five percent. Cross-sectional area measurements were not affected by contaminants in the sewer. Scum deposits on the walls of the gage significantly and adversely affected the accuracy of the velocity readings.

(EPA)

W74-09061

#### METALLIC RECOVERY FROM WASTE WATERS UTILIZING CEMENTATION,

American Brass Co., Westbury, Conn. Div. of Engineered Environments.  
O. P. Case.  
Copy Available from GPO Sup Doc as EPI-23-670/2-74-008, \$0.85; microfiche from NTIS as PB-233 143 \$1.45. Environmental Protection Agency, Technology Series Report, EPA-670/2-74-008, January 1974. 36 p, 10 fig, 5 tab, 12 ref. EPA Program Element IBB-36 Grant No S-802254.

Descriptors: Pollution abatement, Chemical wastes, \*Industrial wastes, Recycling, \*Waste water treatment, Electrochemistry, Waste treatment, Copper.

Identifiers: Copper recovery, Hexavalent chromium reduction, \*Electrochemical reduction, Electrochemical replacement, \*Cementation (Electrochemical), Iron reductant, Particulate iron, Alkali earth metal-silicon alloys, \*Metal finishing wastes, \*Metal recovery.

Bench-scale experiments utilizing the 'cementation' reaction (ie electrochemical reduction by contact with a metal of higher oxidation potential) for the precipitation of copper and the reduction of hexavalent chromium in industrial waste streams were performed. Reductants included: soft iron shot 4.37 mm dia, particulate iron approximately -400 mesh and alkali earth metal-silicon alloys in granular form. Soft iron shot was found to be an effective reductant. Below pH 3.0 chromium reduction is rapid and quantitative. Copper cementation is slower and is influenced more strongly by oxygen, speed of mixing, and available iron surface. Previously deposited copper does not significantly impede further copper deposition. Copper catalyzes the chromium reduction. Particulate iron was not as satisfactory as the iron shot due to 'clumping' of the particles when they became coated with copper. Silicon alloys were effective for removal of copper, zinc and trivalent chromium, but not reliable for hexavalent chromium since the reaction is not primarily a reducing one. (EPA)

W74-09062

#### CHEMICAL/PHYSICAL AND BIOLOGICAL TREATMENT OF WOOL PROCESSING WASTES,

Metcalf and Eddy, Inc., Boston Mass.  
L. T. Hatch, R. E. Sharpin, and W. T. Wirtanen.  
Copy Available from GPO Sup Doc as EPI-23-660/2-73-036, \$1.05; microfiche from NTIS as PB-233 137 \$1.45. Environmental Protection Agency, Technology Series Report EPA-660/2-73-036, January 1974. 57 p, 18 fig, 22 tab, 20 ref. EPA Project 12130 HFX.

Descriptors: \*Waste water treatment, Water quality control, Pollution abatement, Treatment facilities, \*Industrial wastes, Pilot plants, Physicochemical properties, Activated sludge, \*Biochemical oxygen demand, \*Chemical oxygen demand, \*Suspended solids.

Identifiers: \*Wool scouring waste water, Chemically/Physically treated grease removal, Biological organic removal, Temperature effects, \*Acid-cracking treatment.

Elevated temperature acid cracking combined with pilot activated sludge and lagoon treatment were utilized to treat effluent wastewater from a woolen processing plant. Effluent from woolen 'top' (raw wool scouring) making is very high in biochemical oxygen demand (BOD), chemical oxygen demand (COD), and suspended solids (SS) (18,880 ppm, 60,600/ppm, and 37,600 ppm, respectively). The chemical/physical system consisted of a hot acid-cracking process to reduce the grease content in the influent to the biological system. Average grease reductions were from 13,400 milligrams per liter (mg/L) to 120 mg/L or 99 percent with a BOD reduction of 70 percent and COD reduction of 80 percent. The biological system consisted of a pilot extended aeration activated sludge unit with clarification and retention in a pilot facultative lagoon (53 days' retention). Typical BOD and COD reductions in the activated sludge/clarification unit were 83 percent and 54 percent, respectively, and in the lagoon 56 percent and 54 percent, respectively. (EPA)

W74-09064

#### TREATMENT OF SULFITE EVAPORATOR CONDENSATES FOR RECOVERY OF VOLATILE COMPONENTS,

Institute of Paper Chemistry, Appleton, Wis. Div. of Industrial and Environmental Systems.  
K. W. Baierl, N. L. Chang, B. F. Lueck, A. J. Wiley, and R. A. Holm.  
Copy Available from GPO Sup Doc as EPI-23-660/2-73-030, \$2.10; microfiche from NTIS as PB-233 139 \$1.45. Environmental Protection Agency, Technology Series Report EPA-660/2-73-030, December 1973. 168 p, 52 fig, 28 tab. EPA Program Element 1B2037 Grant S801207.

Descriptors: \*Waste water treatment, \*Evaporators, \*Condensation, Activated carbon, Adsorption, Lignins, Solvent extractions, Separation techniques, \*Distillation, Alcohols, Acids, Organic acids, Pulp wastes, \*Pulp and paper industry, Biochemical oxygen demand, Chemical oxygen demand, Water pollution, Industrial wastes, Heat balance, Mass transfer, \*Sulfite liquors.

Identifiers: Steam stripping, Fractional distillation, Spent sulfite liquor, Acetic acid, Methanol, Furfural, Ethyl acetate, Volatile acids, Neutral volatiles, Nonvolatile organics, Lignin, Lignosulfonic acids.

Pilot studies were conducted on two routes for recovery of volatile components in condensates from evaporation of spent liquors from acid sulfite pulping. The condensates were steam stripped prior to adsorption on activated carbon. The first route utilized fractional distillation and solvent extraction from the carbon, while the second route used low-temperature thermal regeneration. Relatively pure SO<sub>2</sub>, methanol, furfural, and ethyl acetate were recovered. Estimated process economy, based upon recovery of saleable volatiles, favorable mass and heat balances, and credits for BOD removal, indicates the first route may provide a favorable method for the removal of pollutants from condensates. Low temperature regeneration studies failed due to mechanical design problems, but this second route continues to be considered as technically feasible. In an important auxiliary study, a substantial number of condensate samples from cooperating mills were analyzed. Differences in quality, quantity, and dilution of the condensates from different sources were apparent. Individual design of processing facilities for each mill is indicated, and especially so in those mills where backwashing of the evaporators contaminate the condensate with non-volatile materials. (EPA)

W74-09066

#### INVENTORY OF WASTE WATER PRODUCTION AND WASTE WATER RECLAMATION PRACTICES IN CALIFORNIA, 1970-1971,

California State Dept. of Water Resources, Sacramento.  
C. F. Kleins, and W. B. Mitchell.  
Bulletin No 68-71, November 1972. 35 p, 1 fig, 6 tab.

Descriptors: \*Water reuse, \*Reclaimed water, \*California, Water supply, Census, Water sources, Sewage effluents, Waste water disposal, Irrigation, Tertiary treatment, Waste water treatment.

A summary of the status of municipal, industrial, and domestic waste water production and reclamation in California by local governmental units, federal institutions, and private enterprises is compiled for the years 1971-1972. About 175,000 acre-feet of water was reclaimed and reused out of a potential 2.3 million acre-feet of waste water according to 766 dischargers in 1970 compared to 190,000 acre-feet out of 2.5 million reported by 805 dischargers in 1971. Some 339,000 acre-feet in 1970 and 409,000 acre-feet in 1971 of treated municipal and industrial wastes were discharged into streams, lakes, reservoirs, and groundwater basins, thereby providing a readily available

source of reusable water. Sewage systems producing less than 10 acre-feet annually and home domestic systems were not evaluated. The study, broken down into hydrologic units, shows the Southern Coastal and Tulare Basins as the largest reclaimers. While the Tulare Basin reclaimed 75% of its waste water, the Southern Coastal Basin reclaimed 5%, comparable to other coastal areas. Inland, the majority of the waste water is either reclaimed or returned to freshwater sources for future use. Over half of the waste water produced by the state, however, is lost through discharges into saline waters. (Schroeder-Wisconsin)  
W74-09078

**WASTE TREATMENT: UPGRADING POULTRY-PROCESSING FACILITIES TO REDUCE POLLUTION.**  
Giffels Associates, Inc., Detroit, Mich.  
Environmental Protection Agency Technology Transfer Seminar Publication 3, July 1973. 48 p, 24 fig, 5 tab.

Descriptors: \*Waste water treatment, \*Poultry, \*Planning, Industrial wastes, Florida, Treatment facilities, Design, Operation and maintenance, Sites, Effluents, Lagoons.  
Identifiers: \*Poultry processing wastes, Case history, Gold Kist(Fla.).

The quantity of waste water from poultry processing ranges from 5-10 gallon/bird and is typically higher than domestic sewage in BOD. The initial planning requirements to implement wastewater treatment in a poultry processing plant are discussed. Planning begins by identifying effluent sources and by examining local waste discharge standards. Secondary treatment processes evaluated include activated sludge, standard and high-rate trickling filters, and aerobic and anaerobic lagoons. With the exception of anaerobic lagoons, each of the above methods will achieve a 70-90% reduction in BOD and 80-95% removal of suspended solids. The major cost advantages for an activated sludge and trickling-filter process are construction and land costs, while land utilization costs represent the major expense for lagoons. Lagoons represent the most prevalent poultry wastes treatment process. The operating procedures for treatment plants, providing daily, weekly, monthly, and yearly checklists are listed. A case history of the Gold Kist Poultry Processing Plant in Florida is analyzed. The plant was originally designed for 50,000 birds/day per shift and has currently been expanded to 130,000 birds/day. Capital costs and operating cost per bird for the 1967 treatment plant was 0.1 and 0.06 cents/dressed pound. (Schroeder-Wisconsin)  
W74-09079

**DESIGN AND OPERATION OF LAND TREATMENT SYSTEMS FOR MINIMUM CONTAMINATION OF GROUND WATER.**  
Agricultural Research Service, Phoenix, Ariz.  
Water Conservation Lab.  
H. Bouwer.  
Ground Water, Vol 12, No 3, p 140-147, May-June 1974. 5 fig, 16 ref.

Descriptors: \*Waste water disposal, \*Artificial recharge, \*Irrigation, \*Water spreading, Groundwater, Water reuse, Water conservation.  
Identifiers: \*Land disposal(Wastes).

Low-rate or irrigation-type systems for land application of sewage effluent or similar waste water are often used in humid areas because they have a small impact on the underlying groundwater. In arid areas, low-rate systems cannot be used to produce renovated water for groundwater recharge, because the renovated water will have a much higher salt content than the effluent. Renovated water of relatively low salt content can only be produced with high-rate systems. Such systems, which require permeable soil, can also be used in humid areas to reduce the land require-

ments. To minimize the impact of high-rate systems on groundwater quality, the system should be managed to remove as much of the pollutants (particularly nitrogen and phosphorus) as possible from the waste water as it seeps through the soil, and to restrict the spread of renovated waste water in the groundwater basin. Nitrogen removal can be maximized by stimulating denitrification in the soil. Certain soils can store large quantities of phosphate. The spread of renovated water in the groundwater can be controlled by intercepting the flow of renovated water with wells or drains for reuse or discharge into surface water. Techniques for predicting the underground flow system are presented. (Knapp-USGS)  
W74-09089

**PROTRACTED RECHARGE OF TREATED SEWAGE INTO SAND: PART I—QUALITY CHANGES IN VERTICAL TRANSPORT THROUGH THE SAND.**  
Rensselaer Polytechnic Inst. Troy, N.Y. Dept. of Environmental Engineering.  
D. B. Aulenbach, T. P. Glavin, and J. A. Romero Rojas.  
Ground Water, Vol 12, No 3, p 161-169, May-June 1974. 10 fig, 1 tab, 16 ref.

Descriptors: \*Artificial recharge, \*Waste water disposal, Water spreading, Lakes, Water pollution control, Water quality control, Filtration, Tertiary treatment, \*Water reuse, New York.  
Identifiers: \*Lake George(N.Y.).

When the Lake George, New York, sewage treatment plant was put into operation in 1939, it was described as a complete treatment plant because the treated effluent is discharged onto sand seepage beds which are at least 25 feet deep. When beds were dosed, they were not saturated with water below 15 feet. Ten feet of sand removes coliforms by 99% and BOD by 96%. However, nitrates, phosphates, and chlorides remain in significant concentrations after filtration through 10 feet of sand. Phosphate removal in an infrequently used sand bed is greater than in a continuously used bed. (Knapp-USGS)  
W74-09095

**CONTROLLING POLLUTION.**  
Grove City Coll., Pa. Dept. of Economics.  
H. F. Sennholz.  
The Freeman, Vol 23, No 2, p 67-77, February 1973.

Descriptors: \*Economic impact, \*Industrial production, \*Waste disposal, \*Waste treatment, \*Water pollution sources, Treatment facilities, Federal government, Planning, Long-term planning, Industrial wastes, Industrial water, Municipal wastes, Costs, Prices, Social impact, Water quality, Environment, Economics, Administration, Development, Management, Government finance, Natural resources, Sewage treatment, Sewage disposal, Waste water, Cost allocation, Pollutants.

Pollution is an example of failure of the private enterprise system. Private property and the profit motive are responsible for the ever-increasing quantities of wastes and effluents, and the by-products of production and consumption such as gases, solid or liquid wastes, heat and noise pollution and industrial effluents which overload the environment and are injurious to human, animal and plant life. Large blocs of "externalities"—social costs not included in private costs, are destroying the physical environment according to economists. Almost 3 billion tons of residue are going back into the environment annually. Ad hoc taxes and government restrictions are not enough to cope with the growing problem. Central, or at least regional control is needed, as well as a new economics that considers waste disposal an integral part of the production and consumption process. The blame ultimately, is not laid on

private businessmen, but on government itself rendering economic services in a primitive manner. According to a 1968 study by the Bureau of Solid Waste Management, only 64% of the nation's people lived in communities with refuse collection systems. (Silber-Florida)  
W74-09128

**OVER 40 YEARS OF REGIONAL SERVICES.**  
Hartford Metropolitan District, Water Bureau, Conn.  
For primary bibliographic entry see Field 6E.  
W74-09146

**COUNTY SANITATION FACILITIES INSPECTION.**  
For primary bibliographic entry see Field 6E.  
W74-09165

**PROCESS FOR REMOVING OIL AND OTHER ORGANIC CONTAMINANTS FROM WATER.**  
Col-Mont Corp., Butte, Mont. (Assignee)  
C. O. Bunn.  
U. S. Patent No 3,798,158, 7 p, 3 fig, 5 ref; Official Gazette of the United States Patent Office, Vol 920, No 3, p 871, March 19, 1974.

Descriptors: \*Patents, \*Oil pollution, \*Organic wastes, \*Waste water treatment, \*Pollution abatement, \*Oily water, Effluents, Activated carbon, Fly ash, Plastics, Specific gravity, Sewage treatment.  
Identifiers: \*Pollution prevention, Carbonaceous materials, Oil refineries, Activated charcoal, Polyethylene, Polypropylene.

A process and equipment are designed to treat the effluent from sewage treatment plants or oil refinery waste treatment facilities. Finely divided carbonaceous material is mixed with the effluent to be purified to form a slurry. The carbonaceous material may consist of finely divided coal, fly ash, powdered carbon, activated carbon or activated charcoal. The slurry is then influenced by specific gravity to stratify with the oil or organic material floating at the surface. The oil-enriched carbonaceous material is then mixed with a powdered plastic material. This mixture is then heated high enough to vaporize and thus strip the sorbed oil from the slurry. At such temperatures the plastic material is softened and adhesively binds the carbonaceous material forming a porous lightweight matrix material which is capable of floating on water. All or a portion of the mixture may be removed with a portion being available for recycling. (Sinha-OEIS)  
W74-09175

**METHOD FOR INSTALLING AERATION SYSTEMS IN SEWAGE TREATMENT TANKS.**  
Water Pollution Control Corp., Milwaukee, Wis. (Assignee)  
P. M. Thayer.  
U. S. Patent No 3,802,676, 4 p, 10 fig, 10 ref; Official Gazette of the United States Patent Office, Vol 921, No 2, p 619, April 9, 1974.

Descriptors: \*Patents, \*Aeration, \*Sewage treatment, \*Waste water treatment, \*Pollution abatement, \*Water pollution control, \*Water quality control, Equipment, Methodology.

A method of installing an aeration system in a sewage treatment tank includes the steps of prefabricating headers having transversely-extending connectors longitudinally spaced along the header. Next the connectors are threaded to receive air diffusers which support the header in a tank to extend horizontally therein. The position of support of the header is adjusted to obtain a desired uniform depth in the tank for the header. The header is leveled and rotated on its axis to level the connectors, and air diffusers are attached to the connectors. (Sinha-OEIS)  
W74-09176

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5D—Waste Treatment Processes

#### APPARATUS FOR EFFECTING PURIFICATION OF LIQUIDS BY FLOTATION,

Aktiebolaget Electrolux, Stockholm (Sweden). (Assignee)

S. E. A. Svantesson.

U. S. Patent No. 3,799,345, 4 p, 3 fig, 2 ref; Official Gazette of the United States Patent Office, Vol 920, No 4, p 1201, March 26, 1974.

Descriptors: \*Patents, \*Flotation, \*Water purification, \*Waste water treatment, \*Water pollution treatment, \*Pollution abatement, Equipment, Bubbles.

In the purification of liquids by flotation, a mixture of gas and liquid is subjected to sufficient pressure for the gas to dissolve in the liquid and form a solution of the gas and the liquid. The solution of gas and liquid without any substantial change in pressure is introduced at a low velocity to the body of polluted liquid in a flotation tank. Initially no gas bubbles are formed. As the solution rises slowly in the tank and it is subjected to a gradually lower pressure, gas bubbles are formed in a gentle manner. Due to the slow rate at which this takes place the gas bubbles will be very small. Since a great quantity of gas is dissolved in the liquid, a large quantity of gas bubbles will be formed. All of these factors contribute to an effective purification of polluted liquids by flotation. (Sinha-OEIS)

W74-09180

#### APPARATUS AND METHOD FOR TREATING SEWAGE,

R. Freese.

U.S. Patent No. 3,799,346, 8 p, 13 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 920, No 4, p 1202, March 26, 1974.

Descriptors: \*Patents, \*Pollution abatement, \*Aeration, \*Chlorination, \*Sewage treatment, \*Water pollution control, \*Water quality control, Equipment Waste water treatment.

A primary waste receiving and mixing vessel is provided for receiving raw sewage and breaking down the larger pieces of raw waste to a suspension of small particles in a liquid. This suspension is pumped into a bottom region of an aeration vessel. A venturi aerator is provided on the outlet side of the pump for introducing air into the stream of sewage being pumped into the aeration vessel. The aeration vessel contains a series of downward inclined baffles which are arranged to trap pockets of air and to circulate the sewage along a tortuous path across these air pockets. A recycling system is provided to recycle a portion of aerated sewage from a top region of the aeration vessel back into the primary mixing vessel for mixing with the raw, unaerated sewage and a second recycling system is provided. A settling tank is provided for receiving aerated sewage and separating activated sludge from the liquid portion of the sewage. The liquid portions can be chlorinated and the separated activated sludge is returned to the aeration vessel for mixing with the aerated sewage. (Sinha-OEIS)

W74-09181

#### APPARATUS FOR CLEANING MUDDY WATER,

F. I. Stewart.

U.S. Patent No. 3,799,349, 4 p, 4 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 920, No 4, p 1203, March 26, 1974.

Descriptors: \*Patents, \*Mud, \*Sediment discharge, \*Water treatment, \*Water pollution control, \*Pollution abatement, \*Water quality control, Equipment, Separation techniques, Silt.

To remove mud, sediment or silt from a body of water, a conduit is provided. The conduit is perforated at the top to trap sediment. Within the conduit there is a flexible conveyor which can be moved through the conduit carrying the trapped

sediment out of the conduit for disposal. (Sinha-OEIS)

W74-09182

#### FLOTATION APPARATUS,

Degremont Societe Generale d'Epuracion et d'Assainissement, Rueil-Malmaison (France). (Assignee).

V. Savall, and P. Treille.

U.S. Patent No. 3,799,350, 3 p, 2 fig, 6 ref; Official Gazette of the United States Patent Office, Vol 920, No 4, p 1203, March 26, 1974.

Descriptors: \*Patents, \*Water purification, \*Flotation, \*Waste water treatment, Equipment, Separation techniques, Bubbles.

A flotation apparatus comprises essentially a parallelepipedic tank disposed horizontally and provided along its major axis with open-top, pot-like injectors for the liquid to be treated with another liquid saturated with gas under pressure. The liquid to be treated is delivered through the bottom and preferably centrally of each injector, and the treatment liquid is supplied through a lateraleccentric but non-tangential pipe. Siphons are provided along the major side walls of the tank and are adapted, in conjunction with the injectors, to create outward and downward fluid flow passing under the siphons, other means being provided for removing the top sludge from one end of the tank. (Sinha-OEIS)

W74-09183

#### METHOD AND APPARATUS FOR FLOCCULATION OF DISSOLVED SUBSTANCES,

A. S. King.

U.S. Patent No. 3,801,482, 3 p, 3 fig, 3 ref; Official Gazette of the United States Patent Office, Vol 921, No 1, p 300, April 2, 1974.

Descriptors: \*Patents, \*Nucleation, \*Flocculation, \*Waste water treatment, \*Water pollution treatment, \*Pollution abatement, \*Water quality control, \*Water treatment, Electrolysis.

The fluid to be treated is passed through an electrostatic field to neutralize particles within the fluid and initiate nucleation. The fluid is then subjected to electrolysis to increase nucleation and cause flocculation. Each treater has a metal outer shell which forms an outer electrode and an inner, tubular electrode which is concentrically disposed within the outer electrode. An annular treating region is located between an inlet and an outlet of the outer electrode. (Sinha-OEIS)

W74-09184

#### SEWAGE TREATMENT,

E. Luck.

U.S. Patent No. 3,801,499, 6 p, 11 ref; Official Gazette of the United States Patent Office, Vol 921, No 1, p 304, April 2, 1974.

Descriptors: \*Patents, \*Waste water treatment, \*Sewage treatment, \*Pollution abatement, \*Water pollution treatment, Alkalinity, Metals, pH, Bacteria, Fungi, Yeasts, Enzymes, Neutralization.

Various treatments are interrelated and are carried out so that a preceding treatment improves the capabilities of a succeeding treatment. The method of treating liquid sewage containing inorganic and organic components comprises adding an alkaline compound or a mixture of alkaline compounds, to precipitate out metals as insoluble carbonates, bicarbonates, hydroxides or oxides. The precipitates are easily removed. Sufficient alkaline material is added to raise the pH over 11 to destroy pathogenic and other bacteria. Enzymes from the bacteria are released into solution. Acid is added to lower the pH to 3.5 to 6.5. Bacteria, fungi or yeast are added to assist in decomposing organic components. After removing the dead organisms and other insoluble precipitates, the remaining

liquid is neutralized. The neutralized liquid is then subjected to ion exchange to remove remaining unwanted ions. (Sinha-OEIS)

W74-09185

#### SYSTEM FOR TREATING DILUTE SLURRIES,

Westinghouse Electric Corp., Pittsburgh, Pa. (Assignee).

T. E. Lippert, C. D. Beristain, and M. Testa.

U.S. Patent No. 3,796,317, 4 p, 3 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 920, No 2, p 392, March 12, 1974.

Descriptors: \*Patents, \*Waste water treatment, \*Pollution abatement, \*Water pollution control, \*Water quality control, Slurries, Equipment, Dewatering, Separation techniques. Identifiers: \*Pollution prevention.

A system for removing water from dilute slurries of the type discharged from waste water treatment plants, including feeding the dilute slurry into a reservoir and passing concentrically mounted endless screen and porous belts through the reservoir for absorbing water from the slurry is described. The water is squeezed from the belts and the thickened slurry is transported from the reservoir to a position for discharge onto the screen belt which moves in intimate contact with the porous belt. Such intimate contact facilitates further removal of water from the slurry by capillary action as the belts move linearly towards the end of the system. The belts then separate from each other. Water is squeezed from the porous belt and the screen belt with its slurry cake then runs through a pair of rollers for further slurry dewatering and compaction to a desired solids concentration. The dewatered slurry cake is then transferred to one of the rollers and subsequently removed from the system for ultimate disposal. (Sinha-OEIS)

W74-09188

#### WATER TREATING APPARATUS,

Union Tank Car Co., Chicago, Ill. (Assignee). E. Salem.

U.S. Patent No. 3,796,319, 7 p, 2 fig, 3 ref; Official Gazette of the United States Patent Office, Vol 920, No 2, p 392, March 12, 1974.

Descriptors: \*Patents, \*Water treatment, \*Ion exchange, \*Water purification, \*Water quality control, Resins, Chemical reactions, Separation techniques, Anion exchange, Cation exchange.

Water is passed through a service layer of anion and cation exchange resins in a service zone. Then the water is passed through a leakage barrier layer of cation exchange resin. The anion exchange resin is regenerated in an anion regeneration zone, the cation exchange resin in a cation resin regeneration zone. A portion of the cation exchange resin is transferred to the service zone to establish a leakage barrier layer. The remainder of the cation exchange resin is mixed with the anion exchange resin, and the mixed resins are transferred to the service zone to establish a service layer of anion and cation exchange resins. (Sinha-OEIS)

W74-09189

#### APPARATUS FOR PROCESSING WATER,

Aktiebolaget Gustavsbergs Fabriker (Sweden). (Assignee).

P. E. Kosonen.

U. S. Patent No. 3,796,321, 3 p, 4 fig, 5 ref; Official Gazette of the United States Patent Office, Vol 920, No 2, p 393, March 12, 1974.

Descriptors: \*Patents, \*Waste water treatment, \*Phosphates, \*Chemical precipitation, \*Pollution abatement, \*Water pollution control, \*Water quality control, Potable water, Sedimentation. Identifiers: Aluminum sulfate.

The apparatus comprises a first container in the form of a vertical cylinder to separate larger particles and a second container in the form of a vertical cylinder to separate precipitated particles. The second larger container surrounds the first container so that an annular gap is formed between the walls of the containers. There is a partition wall in the annular gap to form a channel for the supply of water from the first container to a precipitation zone in the annular gap on one side of the partition wall. The precipitate formed is deposited at the bottom of the gap during the passage of the water around the annular gap and the water thus treated passes through an outlet conduit on the other side of the partition wall. The invention specifically relates to the precipitation of phosphates in the waste water by the addition of aluminium sulfate. (Sinha-OEIS)  
W74-09190

#### AERATION APPARATUS FOR LIQUIDS,

J. R. Kaelin.

U.S. Patent No. 3,796,417, 5 p, 2 fig, 3 ref; Official Gazette of the United States Patent Office, Vol 920, No 2, p 417, March 12, 1974.

Descriptors: \*Patents, \*Sewage treatment, \*Waste water treatment, \*Aeration, Equipment, Activated sludge, Impellers.

An aeration impeller consists of two suction sides arranged above one another working in opposed directions. Guide channels connect each suction side with the discharge sides of the aeration impeller. The operation comprises the steps of arranging the aeration impeller in an aeration tank having a subsequently arranged settling tank of a sewage purification plant, and delivering activated sludge from the settling tank to one suction side of the aeration impeller. (Sinha-OEIS)  
W74-09191

#### FEASIBILITY STUDY OF HYDROCYCLONE SYSTEMS FOR DREDGE OPERATIONS,

Oklahoma State Univ., Stillwater. Office of Engineering Research.  
W. G. Tiederman, and M. M. Reischman.  
Available from NTIS, Springfield, Va 22151 AD-766 212 as Price \$5.25 printed copy; \$1.45 microfiche. Army Engineer Waterways Experiment Station Contract Report D-73-1, July 1973. 176 p, 40 fig, 22 tab, 10 ref, 6 append. USCE Contract DACW 39-72-C-0050.

Descriptors: \*Water pollution control, \*Dredging, \*Desilting, \*Separation techniques, \*Sediments, Sedimentation, Flocculation, Silting, Sediment control, \*Waste water treatment.  
Identifiers: \*Hydrocyclones, Chemical treatment.

Hydrocyclone separators were tested for use in concentration and clarification of dredge spoil. The feasibility of using hydrocyclones for the recovery of sand and gravel while rejecting fine silt was also investigated. Six dredge spoil samples, two clay slurries, and one sand were used to determine the effect of particle size, viscosity of the fluid, and inlet solids concentration upon the effectiveness of the hydrocyclones. While the clarification and concentration performance of the hydrocyclones was good on clay slurries, the performance ranged from below average to poor on the spoil samples. The poor capability of the separators to clarify and to concentrate these spoils was due to the combination of high solids content, small particle sizes and highly pseudoplastic (high viscosity) behavior of the spoils. Centrifugation and chemical treatment were also ineffective. Spoils with solids contents less than 100 g/liter could be flocculated but the flocs were too fragile to survive in the hydrocyclones and neither clarification nor concentration was enhanced by the treatment. The high solids content affects clarification more than it does concentration; thus hydrocyclone concentrators were reasonably effective on all but the spoils of highest

solids content. The hydrocyclone was very successful at recovery sand. The hydrocyclone system is recommended for this application of classifying the solids in dredge spoil. (Knapp-USGS)  
W74-09202

#### TRACE METALS IN EFFLUENTS FROM METALLURGICAL OPERATIONS,

Battelle Columbus Lab., Ohio.  
J. B. Hallowell, R. H. Cherry, Jr., and G. R. Smithson, Jr.

In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 75-81, February 1973. 4 fig, 10 tab, 3 ref.

Descriptors: \*Trace elements, \*Water pollution control, \*Industrial wastes, \*Mine wastes, Waste-water treatment, Ion exchange, Oxidation, Evaporation, Biodegradation.

The current pollution control techniques associated with metallurgical operations are listed, and some examples of data describing the behavior of trace metals in waste streams from smelting operations are given. Two basic and relatively long-term approaches to control of pollution by waste streams are modification of processes to minimize or eliminate the waste stream, and segregation of waste streams to minimize the volume to be treated, to allow the use of a specific treatment method, and to maximize the effectiveness of the treatment. The modification of processes generally involves the time and cost associated with research, development, and equipment changes, while the segregation of waste streams usually involves alteration of existing plant facilities. The standard methods of separating suspended solids from liquid waste streams and particulates from gas streams are listed. (See also W74-09206) (Knapp-USGS)  
W74-09212

#### POLLUTION ABATEMENT IN THE METAL FINISHING INDUSTRY,

Environmental Protection Agency, Edison, N.J.  
J. Ciancia.

In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency, National Environmental Research Center, p 83-90, February 1973. 3 fig, 5 tab, 17 ref.

Descriptors: \*Water pollution control, \*Trace elements, \*Industrial wastes, \*Metallurgy, Waste treatment, Water reuse, Air pollution.  
Identifiers: \*Metal finishing.

The wastes produced in metal finishing facilities come mainly from the following sources: the dumping of spent baths; the rinse waters used to wash off process solutions; and accidental waste discharges. Other sources of waste include plant and equipment cleanup, entrainment of mists in exhaust ventilation ducts, regenerants from ion exchange units, and sludges resulting from deposits in process tanks and the precipitation of contaminants from wastes. The methods available for the abatement of pollution may be divided into two general categories: in-plant control techniques for conserving water and eliminating all unnecessary wastes, and the installation of treatment and recovery processes to destroy or remove toxic and objectionable materials in the effluent. (See also W74-09206) (Knapp-USGS)  
W74-09213

#### CONTROL AND PREVENTION OF MINE DRAINAGE,

Environmental Protection Agency, Cincinnati, Ohio.  
R. D. Hill.

In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 91-94, February 1973. 4 tab, 12 ref.

Descriptors: \*Water pollution control, \*Heavy metals, \*Mine drainage, Acid mine water, Mine water, Mine acids, Mine wastes, Water pollution sources, Water pollution treatment, Trace elements, \*Reverse osmosis, \*Waste water treatment.

Polluted mine drainage occurs not only from the mine itself, but also from waste dumps and tailings areas. The ultimate solution to the mine drainage problem is preventing its formation. The reaction is dependent on air (oxygen) and water coming in contact with sulfides. All prevention techniques are based on excluding water and air from the mining environment. Several methods are available to treat the mine drainage that cannot be prevented. The most commonly used method for treating acid mine drainage and removing heavy metals is neutralization. Various ion exchange schemes have been applied to the treatment of coal acid mine drainage. Reverse osmosis (R.O.) also removes multivalent ions from mine drainage. With the use of electrodeposition processes, several metals, such as copper and iron, can be removed from mine drainage. The metal is deposited on the cathode of an electric cell from which it can subsequently be recovered. (See also W74-09206) (Knapp-USGS)  
W74-09214

#### HIGH-RESOLUTION ANALYSES OF REFRACTORY ORGANIC CONSTITUENTS IN AQUEOUS WASTE EFFLUENTS,

Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 5A.  
W74-09226

### 5E. Ultimate Disposal Of Wastes

#### HOUSEHOLD WASTEWATER CHARACTERIZATION,

Baxter and Woodman, Inc., Crystal Lake, Ill.  
For primary bibliographic entry see Field 5B.  
W74-08770

#### THORIUM ISOTOPE CONTENT IN RIVER WATER IN JAPAN,

Meteorological Research Inst., Tokyo (Japan).  
For primary bibliographic entry see Field 5B.  
W74-08772

#### CONTENT OF PLUTONIUM IN RIVER WATER IN JAPAN,

Meteorological Research Inst., Tokyo (Japan).  
For primary bibliographic entry see Field 5B.  
W74-08821

#### LAND APPLICATION OF PROCESSED ORGANIC WASTES,

Ministry of the Environment, Toronto (Ontario). Waste Management Branch.  
For primary bibliographic entry see Field 5D.  
W74-08862

#### THE BALANCE BETWEEN WASTE TREATMENT AND WASTE DISCHARGE IN THE U.S., 1957-2000,

Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.  
For primary bibliographic entry see Field 5D.  
W74-08868

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5E—Ultimate Disposal Of Wastes

**INDUSTRIAL WATER SOFTENER WASTE BRINE RECLAMATION,**  
Culligan, International Co., Northbrook, Ill.  
For primary bibliographic entry see Field 5D.  
W74-08941

**STORAGE AND DISPOSAL OF HIGH LEVEL WASTES,**  
Brandeis Univ., Waltham, Mass. Dept. of Biochemistry.  
For primary bibliographic entry see Field 5C.  
W74-08948

**THE INFLUENCE OF LIQUID WASTE DISPOSAL ON THE GEOCHEMISTRY OF WATER AT THE NATIONAL REACTOR TESTING STATION, IDAHO: 1952-1970,**  
Geological Survey, Idaho Falls, Idaho. Water Resources Div.  
For primary bibliographic entry see Field 5B.  
W74-08962

**QUARTERLY PROGRESS REPORT -- RESEARCH AND DEVELOPMENT ACTIVITIES WASTE FIXATION PROGRAM -- OCTOBER THROUGH DECEMBER 1973,**  
Battelle-Pacific Northwest Lab., Richland, Wash. Nuclear Waste Technology Dept.  
For primary bibliographic entry see Field 5D.  
W74-08965

**NUCLEAR REACTIVITY EVALUATIONS OF 216-Z-9 ENCLOSED TRENCH,**  
Atlantic Richfield Hanford Co., Richland, Wash. Research Dept.  
For primary bibliographic entry see Field 5A.  
W74-08966

**THE ENDOTHERMIC PROCESS--APPLICATION TO IMMOBILIZATION OF HANFORD IN-TANK SOLIDIFIED WASTE,**  
Atlantic Richfield Hanford Co., Richland, Wash. Chemical Processing Div.  
For primary bibliographic entry see Field 5D.  
W74-08968

**DESIGN AND OPERATION OF LAND TREATMENT SYSTEMS FOR MINIMUM CONTAMINATION OF GROUND WATER,**  
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.  
For primary bibliographic entry see Field 5D.  
W74-09089

**PROTRACTED RECHARGE OF TREATED SEWAGE INTO SAND: PART I--QUALITY CHANGES IN VERTICAL TRANSPORT THROUGH THE SAND,**  
Rensselaer Polytechnic Inst. Troy, N.Y. Dept. of Environmental Engineering.  
For primary bibliographic entry see Field 5D.  
W74-09095

### 5F. Water Treatment and Quality Alteration

**DEEP-BED FILTRATION,**  
BAMAG Verfahrenstechnik G.m.b.H., Butzbach (West Germany).  
H. Jung, and E. S. Savage.  
Journal of American Water Works Association, Vol 66, No 2, p 73-78, February, 1974. 10 fig, 2 tab, 5 ref.

Descriptors: \*Design standards, \*Filtration, \*Filters, Potable water, \*Water treatment, Waste water treatment.  
Identifiers: \*Germany, Deep bed filters, Backwash.

The advantages and disadvantages of deep bed filters which are utilized in Europe and other parts of the world are illustrated. Their chief advantage is their high specific loading. They make possible long filter runs and more finished water per wash than do shallower systems. They need less backwash water than do other systems. In some cases pretreatment can be reduced or eliminated. A disadvantage of deep bed systems is that deeper filter vessels are required which may preclude using such a system. In general, the trend is toward the deeper vessels because they avoid negative head loss in the filters at the end of each cycle. With deep beds and air water backwash, coarse media and low head loss filter bottoms may be used. The overall head loss is no more than generally experienced with shallower filters and in many cases may be less. Special consideration should be given to deep bed systems for process and potable water filtration when filter optimization is desired or the quantity of backwash water generated must be held to a minimum. (Merritt-FIRL)  
W74-08784

**HERE AND THERE.**  
For primary bibliographic entry see Field 5D.  
W74-08785

**DIRECT FILTRATION: AN ECONOMIC ANSWER TO A CITY'S WATER NEEDS,**  
Springfield Municipal Water Works, Mass. Water Dept.  
For primary bibliographic entry see Field 5D.  
W74-08788

**PHOSPHATE REMOVAL BY MAGNETIC FILTRATION,**  
Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.  
For primary bibliographic entry see Field 5D.  
W74-08789

**CITY OF BRADFORD WATER DEPARTMENT, CHELOW HEIGHTS TREATMENT PLANT.**  
Water and Waste Treatment, Vol 16, No 11, p 21-22, November, 1973. 3 fig.

Descriptors: \*Water treatment, \*Filtration, \*Reservoirs, Filters, \*Treatment facilities.  
Identifiers: \*United Kingdom.

The Chellow Heights water treatment plant is discussed. A filter building was constructed to replace, with a higher capacity, the existing outmoded filters. Also a new precipitation tank increases existing precipitation capacity. Maximum throughput was designed to be 40 mgd (1.60 cu m/sec). A covered service water reservoir is currently under construction and has a capacity of 140,000 cu m (30.8 mg). It is based on the prime elements of reinforced concrete walls, reinforced concrete columns, and a reinforced concrete roof. (Merritt-FIRL)  
W74-08795

**UNIVERSITY CREDITS FEEDWATER TREATMENT PROGRAM FOR 50% CUT IN BOILER CLEANING WORK LOAD.**  
For primary bibliographic entry see Field 8G.  
W74-08797

**STARTUP AND OPERATION OF THE ROCKVILLE WATER TREATMENT PLANT,**  
Rockville Water and Aqueduct Co., Conn.  
J. R. McQueen.  
Journal of the New England Water Works Association, Vol 88, No 1, p 25-31, March, 1974.

Descriptors: \*Treatment facilities, \*Operation, Costs, Water quality, Water purification, \*Waste water treatment, Iron, Activated carbon, Odor, Taste, \*Connecticut, \*Water treatment.

Identifiers: Manganese, Rockville(Conn).

The startup and operation of the Rockville Water Treatment Plant is described. The plant is the result of 2 1/2 yr of planning and \$2 1/4 million. Treatment in Rockville prior to this rapid sand filter plant consisted of chlorination which began in 1929, the addition of caustic soda in 1966 for corrosion control within the distribution system, and fluoridation required by state law in 1968. Complete startup took 18 days. On May 1, 1970 raw water began flowing through the plant and discharging back in Lake Shenipsit through the overflow piping of one of the clear water storage tanks. This was followed by chemical treatment stabilization, Board of Health inspections, and some piping changes. Five operators work a rotating shift schedule which requires that each operator would be involved in all aspects of the plant's operation and maintenance. The plant has effected a great improvement in water quality delivered to the system. Water color at the plant has been reduced from 10-30 to 2 units or less. Iron and manganese have been removed. Continuous activated carbon treatment has removed undesirable tastes and odors from the water. (Merritt-FIRL)  
W74-08872

**FORT WORTH WATER SUPPLY AND TREATMENT PLANT DEDICATED.**  
For primary bibliographic entry see Field 5D.  
W74-08904

**DESIGN OF FILTRATION PLANT FOR ROCKVILLE, CONNECTICUT,**  
Metcalf and Eddy, Inc., Boston, Mass.  
A. Gammon.  
Journal of the New England Water Works Association, Vol 88, No 1, p 19-24, March, 1974.

Descriptors: \*Filtration, \*Treatment facilities, \*Design, Reservoirs, \*Flexibility, Chemical treatment, Water purification, Pumping station, Buildings, Flocculation, Filters, Oxidation lagoons, Sludge disposal, Sludge storage, \*Waste water treatment, \*Connecticut.  
Identifiers: \*Rockville(Conn).

The design of a rapid sand filtration plant for the Shenipsit Lake Reservoir in Rockville, Connecticut is described. Due to the variations in raw water characteristics such as temperature from winter to summer, color, tastes, and odors, flexibility of chemical treatment was an important design consideration. The new low lift pumping station houses two 7.5 mgd vertical turbine pumps with space to permit the future installation of a third unit. The operations building houses all chemical storage and feeding equipment, with the exception of chlorine gas and sodium hydroxide. Each of the two treatment units has a flocculating compartment, a settling compartment, and a filtering compartment, all arranged concentrically with a 65 ft diameter circular tank. Lagoons were built to handle the waste water from filter backwashing, with sufficient volume to allow freezing of the sludge for ease in handling and disposal. (Merritt-FIRL)  
W74-08910

**ORGANIC AND COLOR REMOVAL FROM WATER SUPPLIES BY SYNTHETIC RESINOUS ADSORBENTS,**  
Alaska Univ., College. Environmental Quality Engineering and Civil Engineering.  
For primary bibliographic entry see Field 5D.  
W74-09050

**OVER 40 YEARS OF REGIONAL SERVICES,**  
Hartford Metropolitan District, Water Bureau, Conn.  
For primary bibliographic entry see Field 6E.  
W74-09146

## WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

### Water Quality Control—Group 5G

#### PUBLIC WATER SUPPLY, SEWERAGE AND SOLID WASTE DISPOSAL SYSTEM.

For primary bibliographic entry see Field 6E.  
W74-09156

#### POLLUTION CONTROL FACILITIES.

For primary bibliographic entry see Field 6E.  
W74-09158

#### PURE WATER SUPPLY DEVICE.

H. Nishizawa.  
U.S. Patent No. 3,799,344, 3 p, 3 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 920, No 4, p 1201, March 26, 1974.

Descriptors: \*Patents, \*Water supply, \*Ion exchange, Equipment, Water purification, Water treatment.

An electromagnetic valve is interposed in a feed pipe that supplies untreated water and that connects with an ion exchange type pure water producing device. A conductivity detector and a flow passage change-over mechanism including a three-way cock are respectively incorporated and serially connected. A float moves vertically according to the water level in the pure water tank. Its movement is conveyed to a float switch by means of a connecting rod. The float switch is operatively connected to an electric circuit. When the float switch is closed, the electromagnetic valve opens and the feeding of water to the pure water producing device is effected to begin and the pure water is supplied to the pure water tank. (Sinha-OEIS)  
W74-09192

#### CHEMICAL COMPOSITION OF WATER SUPPLIES TO NAVAL AND MARINE CORPS AIR STATIONS.

Naval Air Development Center, Warminster, Pa. Materials Engineering Section.  
For primary bibliographic entry see Field 5A.  
W74-09227

### 5G. Water Quality Control

#### THE RECOVERY OF STREAM MACROBENTHIC COMMUNITIES FROM THE EFFECTS OF ACID MINE DRAINAGE.

Virginia Polytechnic Inst. and State Univ., Blacksburg, Dept. of Biology.  
For primary bibliographic entry see Field 5C.  
W74-08701

#### MAN-MADE LAKES: THEIR PROBLEMS AND ENVIRONMENTAL EFFECTS.

For primary bibliographic entry see Field 4A.  
W74-08747

#### LAKE MEAD, A CASE HISTORY.

Bureau of Reclamation, Denver, Colo.  
For primary bibliographic entry see Field 4A.  
W74-08748

#### SANITARY IMPLICATIONS OF SMALL BOAT POLLUTION IN AN ATLANTIC ESTUARY.

Adelphi Univ., Garden City, N.Y. Inst. of Marine Science.  
J. Cassin, K. Smith, and K. Frenke.  
Environmental Letters, Vol 2, No 2, p 59-63, 1971. 2 tab, 2 ref.

Descriptors: \*Coliforms, \*Navigation, \*Legislation, \*Shellfish, Recreation, Recreation wastes, Boats, Boating regulations, Waste disposal, Pollution.  
Identifiers: New York.

The implications of a New York navigational law forbidding sewage discharge by small pleasure craft into the water were investigated. The study indicates that coliforms increase in water column and shellfish in direct relation to small boat population in three of four recreational areas sampled. (Merritt-FIRL)  
W74-08771

#### ORGANIC MANAGEMENT REDUCES LEACHING OF NITRATE.

H. H. Koepf.  
Bio-Dynamics, No 108, p 20-30, Fall, 1973. 4 tab.

Descriptors: \*Nitrates, \*Farm wastes, Investigations, Fertilizers, \*Soils, Drainage, \*Leaching, Silts, Loam, Runoff, \*Illinois.  
Identifiers: Organic management, \*Waste management.

The reduction of nitrate leaching by the application of organic manuring fluids was investigated and compared with adjacent areas under orthodox commercial farming. The nitrate concentration in the tile drainage runoff was determined in four fields in Buffalo, Ill., from 1969-1973. The average monthly nitrate concentration is tabulated when there was a runoff from the tiles. It is concluded that fertilizing with commercial nitrogen interferes with the changes which the nitrogen continuously undergoes in the soil. The drainage outlets in the soils under investigation are rather close to the surface. Although in these silt loams it might take several months before water from the surface arrives at the depth of these tiles, the tests showed that the biological soil processes are a crucial factor which determines nitrate leaching. The cycles of mobilization-immobilization, nitrate supply for the crops, etc., seem to be different in soils under organic management from those in soils treated chemically. (Merritt-FIRL)  
W74-08773

#### CRITIQUE OF WATER POLLUTION CONTROL ACT.

British Columbia Univ., (Vancouver). Westwater Research Centre.  
A. H. J. Dorsey, and I. K. Fox.  
Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol 100, No EE1, p 141-151, February 1974. 1 tab, 3 ref.

Descriptors: \*Federal Water Pollution Control Act, Standards, \*Planning, Future planning(Projected), Water quality, \*Water quality standards, Water management(Applied), \*Canada.

The approach adopted in the Federal Water Pollution Control Act Amendments of 1972 is discussed. Specifically examined are the procedures envisioned to apply nationwide whereby: effluent and ambient standards are to be established and enforced; basin, state, and regional plans are to be developed; and water quality management facilities are to be financed. It is concluded that Congress may not be the best representative body to make some of the judgments that were made in the legislation; the enormous bureaucracy required by the legislation to achieve national objectives and to plan and implement water quality management programs is not necessary; and the effectiveness of the grant program is questionable. (Merritt-FIRL)  
W74-08774

#### AMERICAN RIVER PLANT ADDS AUTOMATED PUMPING STATION.

For primary bibliographic entry see Field 8C.  
W74-08780

#### DEVELOPMENT TRENDS IN POLLUTION-FREE PROCESSES.

For primary bibliographic entry see Field 5D.

W74-08783

#### ASPECTS OF WATER POLLUTION IN FERTILISER INDUSTRY.

Central Public Health Engineering Research Inst., Nagpur (India).  
For primary bibliographic entry see Field 5C.  
W74-08791

#### INTERACTION EFFECTS OF BORON AND LIME ON BARLEY.

Department of Agriculture, Charlottetown, (Prince Edward Island). Research Station.  
For primary bibliographic entry see Field 3F.  
W74-08799

#### RESPONSE OF SUBIRRIGATED HAY MEADOWS TO THE APPLICATION OF NITROGEN, PHOSPHORUS, AND SULFUR.

Nebraska Univ., Concord. Northeast Station.  
For primary bibliographic entry see Field 3F.  
W74-08802

#### ENVIRONMENT: A BIBLIOGRAPHY OF SOCIAL SCIENCE AND RELATED LITERATURE.

Michigan State Univ., Lansing.  
For primary bibliographic entry see Field 10D.  
W74-08824

#### COMPREHENSIVE MANAGEMENT OF PHOSPHORUS WATER POLLUTION.

Utah Water Research Lab., Logan.  
For primary bibliographic entry see Field 5C.  
W74-08826

#### ENVIRONMENTAL MANAGEMENT AND LOCAL GOVERNMENT.

International City Management Association, Washington, D.C.  
For primary bibliographic entry see Field 6E.  
W74-08827

#### PROMOTING ENVIRONMENTAL QUALITY THROUGH URBAN PLANNING AND CONTROLS.

North Carolina Univ., Chapel Hill. Center for Urban and Regional Studies.  
E. J. Kaiser, K. Elfers, S. Cohn, P. A. Reichert, and M. M. Hufschmidt.  
Environmental Protection Agency, Socioeconomic Studies Series Report EPA-600/5-73-015, February 1974. 441 p, 17 fig, 20 tab, 360 ref.

Descriptors: \*Comprehensive planning, \*Planning, Non-structural alternatives, Social aspects, \*Environmental effects, Land use, Air pollution, Regulation, Legal aspects, Local governments, \*Urbanization, Urban hydrology, Zoning.  
Identifiers: \*Environmental quality, \*Urban guidance systems, Noise.

The study focuses on the changing awareness and current practices in promoting environmental quality through urban planning and controls in local and metropolitan planning agencies. It includes a review of planning practices in the 1960's related to environmental quality; the results of a survey of urban planning agencies with regard to current planning for environmental quality; and a detailed examination of numerous planning approaches and controls considered to be promising for future environmental quality enhancement. The principal areas of concern are land use and comprehensive urban planning, water resource management and urban land-water interfaces, urban design, and the management of air quality and noise. The key concept of integration for the study is the urban guidance system approach which includes various planning activities, deci-

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sion guides such as plans and policy statements, and action instruments such as ordinances, taxes, and public investments. An attempt is made to distinguish between the typical or mainstream planning approaches and controls and those which are new and innovative and therefore appear to have greater potential for promoting environmental quality in the future. Specifically within the water resource management area, the study focuses on two basic types of urban-water interfaces where promising approaches are taking place: those such as watersheds, wetlands, and floodplains where urbanization is taking place and transforming the nature of the water resource; and those such as urban sewerage and drainage systems where urban development has already occurred. (EPA)

W74-08828

**ANALYSIS OF POLLUTION CONTROL COSTS,** Baker (Michael), Jr., Inc., Beaver, Pa. F. J. Doyle, H. G. Bhatt, and J. R. Rapp. Copy Available from GPO Sup Doc as EPI.23-670/2-74-009, \$3.20; microfiche from NTIS as PB-233 026, \$1.45. Environmental Protection Agency Technology Series Report EPA-670/2-74-009, February 1974. EPA Project 14010 HQC.

Descriptors: \*Coal mine wastes, \*Mine drainage, Wastes, Subsidence, Mining, Air pollution, Solid wastes, Erosion control, Sedimentation, Pennsylvania, West Virginia, Maryland, \*Waste treatment, \*Costs, Water pollution control. Identifiers: \*Pollution control costs, \*Monongahela River Basin, Mine sealing, Refuse piles.

This report fulfills requirements for an effective, workable handbook on pollution control costs and factors effecting these costs for the Monongahela River Basin. The information is based on the latest technological developments and cost analyses of recent reclamation projects. Although the report was developed for the Monongahela River Basin study, the cost estimates and supporting data should prove useful for all of Appalachia and other areas with similar topography, mine drainage pollution problems and mining history. Specific areas covered are surface mines, refuse piles, mine sealing, mine drainage treatment, air pollution control, solid waste handling and disposal, abandoned automobiles, and erosion and sedimentation control. (EPA)

W74-08829

**PHOSPHORUS REMOVAL DESIGN SEMINAR, CONFERENCE PROCEEDINGS NO. 1.** Environmental Protection Service, Ottawa (Ontario). For primary bibliographic entry see Field 5D. W74-08846

**A TANNER LOOKS AT THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972,** Widen (R. J.) Co., North Adams, Mass. W. L. Smith. The Journal of the Leather Chemists Association, Vol 69, No 4, p 157-174, April, 1974. 3 fig.

Descriptors: \*Legislation, \*Sewage treatment, \*Effluents, \*Costs, \*Tannery wastes, Municipal wastes. Identifiers: Federal Water Pollution Control Act, Sewage treatment plant.

Costs and technical requirements as ramifications of the new water pollution control law must be considered by the individual tanner at his plant. This is essential when discharging into an existing municipal sewage treatment plant or in planning a tie into a proposed municipal system. Treatment of effluents by the individual tanner is discussed. (Prague-FIRL)

W74-08863

**STREAM STANDARDS: DEAD OR HIDING,** Johns Hopkins Univ., Baltimore, Md. Dept. of Geography and Environmental Engineering. M. G. Wolman. Journal of the Water Pollution Control Federation, Vol 46, No 3, p 431-437, March 1974. 6 ref.

Descriptors: Rivers, \*Streams, \*Stream pollution, \*Water quality standards, Water pollution, Costs, Dissolved oxygen, Dissolved solids, Turbidity, Pollutant identification. Identifiers: \*Stream standards, Biological measures, Standard parameters.

Water quality is not easily quantifiable, but is rather dependent upon perception of use. While the public is attuned to attributes such as algae, murkiness, suds, foam, cans, glass, and debris, scientists try to measure river quality by standard parameters such as dissolved oxygen, acidity, temperature, dissolved solids, turbidity, and biological measures such as the diversity of species, size of the population, and complexity of the system. To translate quality objectives into standards is quite difficult. In addition, economic benefits, as opposed to costs, are vaguely defined. Every water body has more than one polluter along with a number of pollutants, and reasonable standards must vary with perceived use of a particular river. (Prague-FIRL)

W74-08866

**ENVIRONMENTAL TECHNOLOGY AT NORWICH UNIVERSITY,** Norwich Univ., Northfield, Vt. Dept. of Engineering and Technology. For primary bibliographic entry see Field 6G. W74-08871

**RADIOLOGICAL ENVIRONMENTAL MONITORING—THE EPA APPROACH,** Office of Radiation Programs, Washington, D.C. For primary bibliographic entry see Field 5A. W74-08877

**TRENT-WITHAM-ANCHOLME SCHEME AND PROJECT OF THE LINCOLNSHIRE RIVER AUTHORITY,** Lincolnshire River Authority (England). Water Resources Dept. For primary bibliographic entry see Field 6E. W74-08882

**DEVELOPMENT AND FUTURE OF DREDGING,** Corps of Engineers, Atlanta, Ga. South Atlantic Div. A. W. Mohr. Journal of the Waterways Harbors and Coastal Engineering Division, American Society of Civil Engineers, Vol 100, No WW2, p 69-84, May, 1974. 4 tab.

Descriptors: \*Water quality, \*Dredging, \*Equipment, Ecological balance, Channels, Costs. Identifiers: \*Hydraulic dredges, \*Mechanical dredges, Waterway maintenance.

Dredging is performed either to gain the bottom material for fill or commercial use or to create and maintain waterways. This paper is concerned with the latter case, where the material itself is an unwanted by-product. Mechanical and hydraulic dredges are described with a series of tables, indicating the differences between the various types. New dredge designs must take into account the potential ecological damage which they cause, as well as economic advantages. Despite the new water quality requirements, both hydraulic and especially mechanical dredges should continue to have use. (Prague-FIRL)

W74-08893

**IMPACT OF BEACH NOURISHMENT ON DISTRIBUTION OF EMERITA TALPOIDA, THE COMMON MOLE CRAB,** Virginia Univ., Charlottesville. For primary bibliographic entry see Field 5C. W74-08894

**RECENT DEVELOPMENTS ON WATER POLLUTION LEGISLATION,** Environmental Protection Agency, Boston, Mass. Permits Branch. B. R. Sacks. The Journal of the Leather Chemists Association, Vol 69, No 4, p 133-142, April, 1974.

Descriptors: \*Effluents, \*Water pollution control, \*Tannery wastes, \*Legislation, Costs. Identifiers: \*Water pollution legislation, Permits Program, Industry standards, Municipal pollution, Industrial pollution.

Recent water pollution legislation has changed the approaches to effluent problems from both a technical and an economic point of view. The present status of the Permits Program and industry standards for effluent are reviewed in relation to regulation of the leather industry. Topics covered include: history of pollution legislation, municipal pollution, industrial pollution, national standards of performance, water quality standards, enforcement, permits and licenses, tannery wastes, and cost recovery. (Prague-FIRL)

W74-08895

**HOW WELL DO ENGINEERS FORECAST DEMANDS,** Wisconsin Univ., Madison. P. M. Berthouex, and K. Thiele. Water and Sewage Works, Vol 121, No 4, p 54-56, April, 1974. 5 fig, 5 ref.

Descriptors: \*Engineering, \*Forecasting, \*Engineering estimates, Treatment facilities, Water quality, Water quality standards, Design standards, \*Demand. Identifiers: \*Accuracy.

The problems in making accurate engineering forecasts are discussed and methods to reduce the forecasting errors are suggested. Engineers face a difficult task in forecasting population, flows, organic loads, and other design inputs and then trying to design a treatment facility to accommodate these loads and have the real plant eventually function to satisfy standards that may exist, 10, 15, or 20 yr into the future. Changes in water quality standards may confront the engineer as an even greater challenge in future planning than population forecasting. If effluent standards or stream standards were clearly stated and the target were fixed, the engineer could plan the development of a treatment system in stages, according to a long term coordinated plan. He could try to take full advantage of economics of scale, of new technology, and of new design procedures. Uncertainty during design works against the designer accomplishing this goal. The impact of this uncertainty on implementation of pollution control technology is great. (Meritt-FIRL)

W74-08905

**SEWAGE FLOW CONTROL SYSTEM,** For primary bibliographic entry see Field 5D. W74-08916

**NUTRIENT BALANCES FOR THE EVALUATION OF NUTRIENT SOURCES IN WATER QUALITY MANAGEMENT,** Department of the Environment, Ottawa (Ontario). Water Quality Branch. For primary bibliographic entry see Field 5B. W74-08928

**DEVELOPMENT OF WATER QUALITY MODELS USING SPECTRAL ANALYSIS AND PARAMETER ESTIMATION TECHNIQUES,** Kansas State Univ., Manhattan. Dept. of Chemistry.

L. T. Fan, and L. E. Erickson.  
Available from the National Technical Information Service as PB-232 986; \$4.00 in paper copy, \$1.45 in microfiche. Kansas Water Resources Research Institute, Manhattan, Contribution Number 140, (1974). 83 p, 23 fig, 24 tab, 20 ref. OWRR B-021-KAN(8). 14-31-0001-3282.

Descriptors: Water quality, Model studies, Stochastic processes, \*Ohio River, \*Missouri River, \*Mathematical models.  
Identifiers: \*Spectral analysis, Water quality data, \*Water quality models, \*Parameter estimation, Stochastic data, Transient models, \*Detroit River, \*Coosa River.

This research was concerned with the analysis and interpretation of water quality data in order to develop improved mathematical models for predicting water quality. Spectral analysis was employed to analyze water quality data from the Coosa, Detroit, Missouri and Ohio rivers. Using the results of spectral analysis, mathematical models were developed to represent the processes taking place in the stream. Once the structural form of a model was obtained, parameter estimation techniques were used to determine the value of the constants and the parameters in the model equations. The study also includes (1) estimation of missing values in water quality data, (2) experimental simulation of thermal discharge monitoring and application of spectral analysis techniques, (3) compilation of water quality data and parameters from Kansas rivers and streams, (4) identification of parameters in transient water quality models from stochastic data, and (5) evaluation of methods for estimating stream water quality parameters in a transient model from stochastic data. The results of this research were reported in a series of publications, a list of which has been provided in this report. A summary of the significant results is presented under separate headings. The overall conclusion was that the different techniques of data analysis presented here were very effective in analyzing stream quality and would serve as valuable tools in model development.  
W74-08936

**A PLANNED MAINTENANCE MANAGEMENT SYSTEM FOR MUNICIPAL WASTEWATER TREATMENT PLANTS,** EnviroPlan, Inc., College Park, Md. Fairfax County, Va.  
For primary bibliographic entry see Field 5D.  
W74-08944

**DEVELOPMENT OF PREDICTIONS OF FUTURE POLLUTION PROBLEMS,** Battelle-Columbus Labs., Ohio.  
For primary bibliographic entry see Field 5B.  
W74-08946

**THE NUCLEAR SAFEGUARDS PROBLEM,** Cornell Univ., Ithaca, N.Y. Peace Studies Program.  
For primary bibliographic entry see Field 5C.  
W74-08949

**FINAL ENVIRONMENTAL STATEMENT RELATED TO THE PROPOSED HOPE CREEK GENERATING STATION UNITS 1 AND 2,** Directorate of Licensing (AEC), Washington, D.C.  
For primary bibliographic entry see Field 5C.  
W74-08959

**TRANSURANIC SOLID WASTE MANAGEMENT RESEARCH PROGRAMS -- QUARTERLY REPORT, JULY-SEPTEMBER 1973.** Los Alamos Scientific Lab., N. Mex.  
For primary bibliographic entry see Field 5D.  
W74-08963

**ON TAXATION AS A POLLUTION CONTROL POLICY,** Pittsburgh Univ., Pa. Graduate School of Business.  
R. F. Byrne, and M. H. Spiro.  
Swedish Journal of Economics, Vol 75, No 1, p 105-109, 1973. 1 fig, 14 ref. OWRR A-028-PENN(1).

Descriptors: \*Economic efficiency, \*Pollution taxes(Charges), \*Pollution abatement, Standards, Return to scale, Mathematical models, Environmental control, \*Taxes, Industrial plants, Water pollution control.  
Identifiers: Indivisibilities, \*Effluent charges.

It is generally assumed that the use of effluent charges to combat pollution is at least as efficient as the use of pollution standards. It is demonstrated both geometrically and mathematically that such charges may not be efficient when a firm faces a number of productive processes having fixed proportions of pollutants and outputs and constant returns to scale. It is shown geometrically for a firm with two processes and a single input. The alternative process model formulated may be typical of many polluting industries including the steel, phosphate, pulp and paper, and petroleum. The model also covers the common situation where the alternatives consist of one process with or without waste treatment facilities which display indivisibility characteristics. (Schroeder-Wisconsin)  
W74-09049

**FEASIBILITY STUDY OF A NEW SURFACE MINING METHOD 'LONGWALL STRIPPING',** Potomac Engineering and Surveying Co., Petersburg, W. Va.  
H. F. Moomau, F. R. Zachar, and J. W. Leonard.  
Copy Available from GPO Sup Doc as EPI.23:670/2-74-002, \$1.15; microfiche from NTIS as PB-233 146, \$1.45. Environmental Protection Agency, Technology Series Report EPA 670/2-74-002, February 1974. 67 p, 4 fig, 22 ref. EPA Program Element 1BB040. Contract 68-01-0763.

Descriptors: \*Environmental disturbance, \*Surface mining, \*Strip mining, Auger mining, \*Longwall mining, Shortwall mining, Open-end outby, Fresh-air outby, Shallow cover mining, Roof-support, Shearers, Chocks, Conveyors, Continuous miner, Packwalling, Bench, Stowing, Highwall.  
Identifiers: \*Feasibility studies, \*Mining, Coal mines.

'Longwall stripping' is a new surface mining concept developed by the Environmental Protection Agency. Longwall stripping adapts existing underground longwall mining technology for use in recovering shallow cover coal without the total environmental disturbance often associated with surface mining. This study investigated the environmental, mining and economic feasibility of longwall stripping. Longwall stripping was determined to be a feasible method for mining coal under shallow cover. A discussion of the criteria that are necessary to consider in selecting a site and developing the mining plan is included. Additionally, alternate methods of the longwall stripping concept are discussed. (EPA)  
W74-09060

**IN-PROCESS POLLUTION ABATEMENT: UP-GRADING METAL-FINISHING FACILITIES TO REDUCE POLLUTION,** Oxy Metal Finishing Corp., Madison Heights, Mich., Environmental Services Group.

A. E. Olson, and E. N. Hanf.  
Environmental Protection Agency Technology Transfer Seminar Publication 1, July, 1973. 71 p, 25 fig, 4 tab, 14 ref, 2 append.

Descriptors: \*Metallurgy, \*Industrial wastes, \*Pollution abatement, \*Control, Water pollution control, Operations, Waste treatment, Air pollution, Industrial plants, Chemicals, Pollutant identification, Technology, Equipment, Water conservation, Toxins, Design, Safety, Economic justification, Metals.  
Identifiers: \*Metal-finishing industry, Exhaust systems, Ventilation.

A variety of chemicals are utilized in metal finishing to enhance the value of treated items. In-process water pollution abatement techniques are identified including equipment changes, chemical waste reduction, planning to prevent pollution catastrophes, and water conservation techniques. Methods discussed to reduce or eliminate chemical wastes include process substitution, reduction of process solution concentrations, and reduction of finishing solutions carried out over the edge of process tanks. A number of rinsing techniques are examined in attempts to conserve water. The monetary savings generated by the implementation of these methods is illustrated using a case study and cost figures. The ventilation of fumes from work areas and the removal of any contaminant from the exhaust stream that can cause air pollution are examined. Ventilation systems are recommended which meet the Occupational Safety and Health Act Standards and which contain the contaminant to a limited area. Exhaust systems should be constructed of corrosion-resistant and fire-retardant material to ensure long life. Wet scrubbers are designed to abate air pollution hazards with operating data for chrome and nickel-plating evaporator/scrubber systems provided. Appendixes illustrate floor plans, equipment protection, and ventilation systems utilizing pollution control devices. (Schroeder-Wisconsin)  
W74-09080

**A SIMPLE SIMULATION METHOD FOR RIVER SELF-PURIFICATION STUDIES,** Centre Belge d'Etude et de Documentation des Eaux, Liege.  
For primary bibliographic entry see Field 5B.  
W74-09093

**THE TIDE OF INDUSTRIAL WASTE,**  
For primary bibliographic entry see Field 5B.  
W74-09119

**STATE EX REL. LUDWIG V. CITY OF BEMIDJI (ACTION FOR INJUNCTION AND DAMAGES AGAINST CITY FOR POLLUTING RIVER),**  
For primary bibliographic entry see Field 6E.  
W74-09121

**DO NUCLEAR PLANTS MAKE DEADLY NEIGHBORS,** Washington Univ., St. Louis, Mo. Center for the Biology of Natural Systems.  
B. Commoner.  
Today's Health, Vol 50, p 25-27, 59, 62, 64, 67, February 1972. 1 chart.

Descriptors: \*Background radiation, \*Distribution patterns, \*Nuclear reactors, \*Radioactivity, \*Rain, Nuclear wastes, Radioactive fallout, Atmosphere, Air pollution, Nuclear explosions, Radioactive wastes, Strontium radioisotopes, Radioactive waste disposal, Public health, Human diseases, Mortality, Radioactivity effects, Legal aspects, Economic aspects.  
Identifiers: \*Administrative regulations.

Rain can bring radioactivity from the air down to earth. Strontium 90, a chemical similar to calcium,

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cannot penetrate more than an inch of living tissue, but once it is in the body, the isotope becomes closely packed around the living cells of the bone and presents a great risk of cancer. Strontium 90 is similar to calcium, so grass and food crops draw it from the soil, and foods carry it into our bodies. Experiments have shown that every exposure to radiation carries with it some risk of genetic damage or cancer. The United Nations Scientific Committee on the Effects of Atomic Radiation has estimated that due to nuclear tests through 1958 between 2,500 and 100,000 serious genetic defects have occurred. Dr. Ernest Steinglass estimates that fallout may be responsible for 400,000 infant and fetal deaths. In 1963, a research group was established to plan and conduct studies of environmental contamination due to release of radioactivity. The group recommended that radiation standards be reduced to one-tenth their present level. This recommendation was opposed by the Atomic Energy Commission and the nuclear power industry. In 1971 the AEC finally agreed to a reduction in permissible radioactive release. The experience with nuclear power warns that the capability to intrude on the environment far outstrips knowledge of the consequences. (Sperling-Florida) W74-09123

#### IT'S ABOUT TOO LATE FOR TAHOE,

W. Bronson.  
Audubon, Vol 73, No 3, p 49-80, May 1971. 2 photo.

Descriptors: Water pollution, \*Water pollution control, Ecology, \*Watersheds(Basins), \*Zoning, Legal aspects, Legislation, Lakes, Wildlife, Wildlife habitats, Turbidity, Erosion, Eutrophication, Environment, Environmental effects, \*Nevada, Basins, Land management, Lake basins, \*California.  
Identifiers: \*Lake Tahoe.

The Tahoe Regional Planning Agency (TRPA), originally created to prevent the degradation of the Tahoe Basin, has failed to control the rush of urban development. The forest cover of the area, combined with ecological factors such as meadows, streams, lakes and talus slopes provide habitats for many vertebrates. However, TRPA's zoning plans could permit an increase in population in the area from a 1970 level of 28,000 to a possible 335,000. Water quality has been the primary environmental concern at Lake Tahoe, and the threat of water pollution triggered steps toward basin-wide pollution controls. Algae blooms have occurred due to excessive nutrient contribution and the entrance of turbid water through streams where development is proceeding in the watershed. Correction of the problem can only occur by controlling man-caused erosion in the watershed. However, serious siltation is predicted to continue, and if unabated will result in eutrophication of the lake. TRPA, a bi-state commission ratified by Congress in 1969, has done little to prevent the continuing development of the area, and environmentalists are now looking for the federal government to save Lake Tahoe, which is federally owned. (Ritchie-Florida) W74-09124

#### WATER POLLUTION—GOVERNMENTAL ACTIVITIES IN BROWARD COUNTY,

N. S. Davis.  
Florida Planning and Development, Vol 23, No 3, p 1-5, March, 1972.

Descriptors: \*Florida, \*Water pollution sources, \*Waste water disposal, \*Waste disposal, \*Water pollution control, Inter-agency cooperation, Governments, Coordination, Planning, Treatment facilities, Federal government, State governments, Local governments, Water pollution, Water supply, Sewage disposal, Sewage treatment, Farm wastes, Industrial wastes, Municipal wastes, Water quality, Oil wastes, Oceans, Sea water, Shores, Shoreline protection, Water policy.

The physical attributes of water and the legal authority to control pollutants in the water have necessitated intergovernmental responses in Broward County, Florida. Both the interior and coastal waters of Broward County are polluted by both natural and manmade pollutants including dead vegetation, effluent from utility and single installation treatment plants, industrial wastes, laundries, carwashes, on-site disposal facilities, marine toilets, oil from boats, power plants, septic tanks and leaching of soils, especially agricultural areas and fertilized land. Many of the canals in the county are non-flowing waterways with high coliform counts. The major source threatening to contaminate coastal water is wastewater disposal into these offshore waters. The primary interest in this highly urbanized area is in providing an adequate supply of fresh water for domestic purposes and in disposing of the wastewater with the least amount of damage to water sources. The nature of the water pollution problem has created a situation in which federal, state and local governments all have legal authority in the area of water pollution control. Federal funding and planning have stimulated the construction of regional sewage treatment plants, as well as encouraged state and local cooperation. (Silber-Florida) W74-09125

#### FOREST FIRES DAMAGE MORE THAN TREES,

American Forestry Association, Washington, D.C.  
For primary bibliographic entry see Field 4C.  
W74-09126

#### SUSQUEHANNA RIVER BASIN COMPACT,

For primary bibliographic entry see Field 6E.  
W74-09129

#### NUCLEAR ENERGY AND THE ENVIRONMENT, AN INTERVIEW WITH A.G.C. COMMISSIONER DIXIE LEE RAY,

I. McManus.  
American Forests, Vol 79, p 12-15, 42-47, August 1973. 1 chart, 1 tab, 11 photo.

Descriptors: \*Electric power industry, \*Nuclear energy, \*Thermal pollution, \*Nuclear wastes, \*Nuclear engineering, Nuclear reactors, Electric power production, Cooling towers, Heated water, Water cooling, Water pollution sources, Fish farming, Surface irrigation, Materials engineering, Research facilities, Research equipment.  
Identifiers: \*Environmental impact statements, National Environmental Policy Act(NEPA).

Nuclear power plants produce excess heat which must be discharged into the environment. The heat is discharged into either the air or into water which is then cooled in condensers, stored in a cooling pond or tower, and ultimately discharged into a stream or river. Fossil fuel plants also discharge heat, but to a lesser extent than nuclear plants. Heated water may be beneficially employed to irrigate crops and warm the soil, possibly extending the growing season. Heated water can be utilized in aquaculture. The amount of excess heat discharged by breeder reactors now under development is approximately equal to that discharged by modern fossil fuel plants. The breeder concept has been known for a long time. There are several different possibilities for a breeder: a light water breeder, a gas breeder, a molten salt breeder, and a liquid metal breeder. A great deal of study involving all countries has led to the conclusion that liquid metal was the most promising. It is believed that there is now enough basic knowledge to construct a large-scale demonstration plant. Nuclear fusion, which utilizes heavy hydrogen found in seawater, is still a process for the future, but after breeder reactors, it offers the best hope for energy. (Sperling-Florida) W74-09135

#### ONE DAMMED THING AFTER ANOTHER,

G. Marine.  
Environmental Journal, p 14-19, May 1971. 6 photo.

Descriptors: \*Lakes, \*Rivers, \*Dams, \*Environmental effects, Salinity, Irrigation, Artificial lakes, Recreation, Hydroelectric power, Electric power, Hydroelectric plants, Structures, Flow, Floods, Flood control, Land reclamation, Land use, Land management, Swamps.

Dams are artificial objects whose purpose is to block or impede the flow of moving water. Some dams are built to restrict the flow of the water with the purpose of regulating its rate or changing its direction, commonly for the purpose of flood control or to regulate the flow so that areas downstream will be available for agriculture, recreation or settlement. In other cases the flow is regulated so that water will be available for diversion into irrigation ditches. At present, more than two thousand dams in the United States are completely silted, and several thousand more will silt over in the next fifty years. Dams at one time meant jobs, development and cheap electrical power, but dams cause extensive environmental damage and do not normally even pay for themselves. Recent studies show that both flood-control and reclamation dams ruin more land than they protect. Dams can cause salinization as well as other forms of irreparable and irreversible damage to water and land. Recreational benefits of artificial lakes have been exaggerated, and the hydroelectric power produced is not as cheap as it was once thought to be. (Ritchie-Florida) W74-09136

#### WATER DISCHARGE PERMIT PROGRAM BEGINS DESPITE LACK OF EFFLUENT STANDARDS,

J. A. Noone.  
National Journal, Vol 5, p 367-376, March 17, 1973.

Descriptors: \*Water law, \*Permits, \*Water quality control, \*Water pollution control, \*Industrial waste disposal, Regulations, Wastewater disposal, Legal aspects, Water pollution sources, Water policy, Environmental sanitation, Navigable waters, Federal government, Standards, Administrative agencies, Impaired water quality, Sewage disposal, Water permits, Water utilization, Planning, Water resources development, Water management, Governments, Water treatment, Pollution abatement.

After a court imposed delay of 15 months, the federal government has begun the key element in its program to cleanse the nation's water—a system of permits that eventually will control discharges by some 56,000 industrial, agricultural and municipal polluters. The Federal Water Pollution Control Act of 1972 is the mechanism for carrying out the clean-water operation. The act sets exact limits on amounts of pollutants that can be discharged from specific sources. The new law requires all existing dischargers to meet two levels of standards. By July 1, 1977, industries must have the best practicable control technology currently available while publicly owned treatment works must use secondary treatment. By July 1, 1983, industries must use the best available technology economically achievable, while publicly owned sewage treatment works must have the best practicable waste treatment technology over the life of the works. The Act's main intent is to have all wastewater dischargers meet national effluent standards. The Act also retained the system of quality standards for receiving bodies of water. The permit program is the apparatus by which the two-pronged regulatory scheme functions. (Silber-Florida) W74-09138

**ARCTIC PASSAGE—LEGAL HEAVY WEATHER.**  
For primary bibliographic entry see Field 6E.  
W74-09139

**INDUSTRIES WIN FEW CONCESSIONS AS POLLUTION PERMIT PLAN MOVES ON SCHEDULE.**  
For primary bibliographic entry see Field 6E.  
W74-09141

**WATERCRAFT: MARINE TOILETS.**  
For primary bibliographic entry see Field 6E.  
W74-09143

**EFFECTS OF PENDING FEDERAL DRINKING-WATER LEGISLATION.**  
For primary bibliographic entry see Field 6E.  
W74-09147

**WATER IMPROVEMENT COMMISSION.**  
For primary bibliographic entry see Field 6E.  
W74-09148

**PROTECTION AND IMPROVEMENT OF WATERS.**  
For primary bibliographic entry see Field 6E.  
W74-09149

**PUBLIC WATER SUPPLY, SEWERAGE AND SOLID WASTE DISPOSAL SYSTEM.**  
For primary bibliographic entry see Field 6E.  
W74-09156

**NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION.**  
For primary bibliographic entry see Field 6E.  
W74-09163

**WHO OWNS THE WATER.**  
For primary bibliographic entry see Field 6E.  
W74-09164

**FLOATING BOOM.**  
N. P. Cerasari.  
U. S. Patent No 3,800,542, 4 p, 13 fig, 4 ref; Official Gazette of the United States Patent Office, Vol 921, No 1, p 68, April 2, 1974.

Descriptors: \*Patents, \*Oil spills, \*Oil pollution, \*Pollution abatement, \*Water pollution control, \*Water quality control, Separation techniques, Equipment, Barriers.

A floating boom can be towed by a vessel around an oil spill or mass of flotsam to collect and contain it. The curved upper end of the support part decreases losses due to wave action. The floating boom comprises at least three connector cables; the barricade may be solid, semi-permeable, or perforated. Horizontally spaced upright supports are attached to the cables. The supports have an upper curved section and a weighted end part, as well as valves for inflating the buoyant support tubes with compressed gas. (Sinha-OEIS)  
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**APPARATUS FOR REMOVING OIL FROM WATER.**  
H. V. Hess, and E. L. Cole.  
U. S. Patent No 3,800,950, 4 p, 5 fig, 7 ref; Official Gazette of the United States Patent Office, Vol 921, No 1, p 172, April 2, 1974.

Descriptors: \*Patents, \*Oil spills, \*Oil pollution, \*Pollution abatement, \*Water pollution control, \*Water quality control, Separation techniques, Foam.

Identifiers: Polystyrene foam, Agglomeration, Oleophilic plastic foam.

The method involves projecting open cellular particles of a highly oleophilic plastic foam such as polystyrene having a solvent affinity for petroleum. The oil agglomerates into lumps which can be contained and then burned or otherwise disposed of. The apparatus for carrying out the method includes a heated foaming vessel supplied with foamable plastic particles and means for projecting the particles, after they have been foamed or expanded, upon oil floating on a water surface. These means include a barrel to which the foamed particles are conveyed as well as propulsive means which disintegrate the foamed particles into relatively small particulates, which are then cast onto the oil. Preferably the oil is surrounded by the foamed particles. The apparatus can be mounted on a barge or other vessel. (Sinha-OEIS)  
W74-09178

**FEASIBILITY STUDY OF HYDROCYCLONE SYSTEMS FOR DREDGE OPERATIONS.**  
Oklahoma State Univ., Stillwater. Office of Engineering Research.  
For primary bibliographic entry see Field 5D.  
W74-09202

**CENTRIFUGE COALESCER CONCEPT FOR SEPARATING OIL FROM WATER DISCHARGED FROM SHIPS.**  
Foster-Miller Associates, Inc., Waltham, Mass.  
A. C. Harvey, A. R. Guzdar, V. K. Stokes, and A. T. Fisk.  
Available from NTIS, Springfield, Va 22151 as AD-764 006, price \$12.75 printed copy; \$1.45 microfiche. Contract Report No 734305.2/3 for U.S. Coast Guard, February 20, 1973. 203 p, 56 fig, 16 tab, 14 ref, 3 append. 4305. Coast Guard Contract DOT-CG-24287 A.

Descriptors: Oil water, \*Ships, \*Separation techniques, \*Centrifugation, Particle size, Water pollution control, Waste water treatment, \*Oil wastes, Pollution abatement, Oil pollution.

A centrifuge was conceived and tested for separation of oil as it is usually dispersed in the bilge and ballast water of ships. The centrifuge is unusual in having predominantly axial flow, allowing comparatively high throughput and low speed. It has both primary and secondary stages of separation and is thus capable of operating with high input concentrations. The device was tested in the laboratory using mixers in a storage tank and a centrifugal pump to disperse up to 8% oil in water. Effluent concentration in the range of 10 ppm were obtained with inputs containing 1000 ppm of No. 2, No. 4 and Nigerian Crude Oils. At higher concentrations ranging up to 58,800 ppm for No. 2 oil and 18,900 for No. 4 oil the effluent contained less than 100 ppm. Centrifuge performance on No. 2 and No. 4 oils containing 10% Gamlen D was lower than with pure oils. Coalescence occurred but produced drops smaller than with pure oils requiring a modification to the separator design. (Knapp-USGS)  
W74-09203

**CYCLING AND CONTROL OF METALS.**  
For primary bibliographic entry see Field 5B.  
W74-09206

**FAILURE OF BRIBES AND STANDARDS FOR POLLUTION ABATEMENT.**  
Resources for the Future, Inc., Washington, D.C.  
T. Page.  
Natural Resources Journal, Vol 13, No 4, p 677-704, 1973. 4 fig, 20 ref.

Descriptors: \*Pollution abatement, \*Equity, \*Industries, Water quality standards, Costs, Regulation, Permits, Governments, Economic efficien-

cy, Welfare(Economics), \*Pollution taxes(Charges), Government supports.

Coase's paper 'The Problem of Social Cost' (J. Law and Econ 1, 1960) instigated a series of discussions which emphasized the symmetrical nature of bribes and charges in achieving Pareto optimal solutions in the presence of externalities. The assumption of symmetry is challenged. Two questions are examined. First, the outcomes from bribes and charges, and standards and fees assuming free entry and exits and two industries—one polluting and one not—are generated. Equity conditions are also generated for the movement from pre to post regulation periods. The production function for the polluting industry assumes pollution is a factor of production rather than as a joint product. Pollution abatement is accomplished through the addition of pollution control equipment, changes in production practices, or reduction in output. Results from the modeling effort reveal that free entry and exit make standards and traditionally imposed bribes inefficient. Bribe systems designed to avoid the inefficiency appear either to closely resemble a fee system or to introduce a number of permanent inequalities. The fee system was found to be the best method of achieving both efficient and equitable results. (See also W74-09241) (Schroeder-Wisconsin)  
W74-09240

**BRIBES AND CHARGES IN POLLUTION CONTROL: AN ASPECT OF THE COASE CONTROVERSY.**  
Resources for the Future, Inc., Washington, D.C.  
A. V. Kneese, and K-G. Maler.  
Natural Resources Journal, Vol 13, No 4, p 705-716, 1973. 2 fig, 9 ref.

Descriptors: \*Water pollution control, \*Non-structural alternatives, \*Pollution taxes(Charges), \*Government supports, Industries, Welfare(Economics), Economic efficiency, Mathematical models.  
Identifiers: Property rights, Equilibrium model.

Coase initiated an intensive debate over the neutrality of property rights in an efficient allocation of resources. Several authors have claimed that the results are asymmetrical with respect to bribes versus charges. Critics have suggested, for example, that the analysis neglected differences in profit levels which result from varying property rights. Both a graphical analysis and a mathematical general equilibrium model are presented to prove the symmetry conditions. Three situations are examined under the general equilibrium model: (1) Pure charges strategy; (2) a mixed strategy utilizing both bribes and charges; and (3) a pure bribe strategy. It is shown that all three cases can lead to an efficient outcome. However, proof of symmetry is a hollow victory. The information requirements to yield an efficient system of bribes are tremendous. The federal government presently engages in subsidies to encourage pollution abatement. Generally, however, such subsidies are not tied to actual pollution reduction, but to construction cost of waste treatment facilities and may bias the economic alternatives of treatment techniques by not subsidizing by-products. (See also W74-09240) (Schroeder-Wisconsin)  
W74-09241

**THE ECONOMICS OF ENVIRONMENTAL QUALITY MEASUREMENT.**  
Ecology Audits, Inc., Dallas, Tex.  
R. H. Schulze.  
Journal of the Air Pollution Control Association, Vol 23, No 8, p 671-675, 1973. 5 tab.

Descriptors: \*Pollutants, \*Measurement, \*Costs, \*Professional personnel, Industries, Training, \*Pollution abatement.  
Identifiers: Environmental consultants.

## Field 5—WATER QUALITY MANAGEMENT AND PROTECTION

### Group 5G—Water Quality Control

The choice between employing environmental consultants and an in-house staff to evaluate the quality of air and water discharges is examined. Figures developed show daily in-house costs covering salaries, fringe benefits, supportive services, and recruitment, by employment categories. Also to be considered are cost of capital equipment and the costs of learning to utilize equipment and the regulatory agencies' framework. Alternatively, service company costs generally are a 2.5-5 multiple of base salaries, depending on part on the length of the contractual arrangement. Billing practices also vary, with some firms charging for all time consumed while other utilizing a rate equal to the time required for a seasoned professional. Also to be weighed are noneconomic factors for an in-house approach including secrecy, making-work, and flexibility, against assumptions of impartiality, availability, cost control and experience which favor a specific service. In general firms having \$60,000/year of work per location expenditure with a service agency should consider an in-house process with subsequent auditing by a service agency. With \$20,000-60,000 expenditures, in-house should still be considered if it can use under-utilized man hours. In each of these cases, cost is based on information of full time personnel handling these evaluations exclusively. (Schroeder-Wisconsin)  
W74-09243

#### POLLUTION ABATEMENT IN A COPPER WIRE MILL.

Environmental Protection Agency, Washington, D.C. Div. of Technology Transfer. EPA Technology Transfer Capsule Report 3. Industrial Demonstration Grant with Volco Brass and Copper Company, 1973. 11 p, 1 fig, 2 tab.

Descriptors: \*Water pollution control, \*Industrial wastes, \*Water reuse, Economics, Profit, Copper, \*Pollution abatement.  
Identifiers: \*Copper wire mill.

All copper wire drawing operations require cleaning of the rods before drawing to prevent impurities from being pulled into the drawn wire. This cleaning process, using hydrochloric or sulfuric acid, poses a number of effluent problems which when treated by traditional precipitation methods without changes in the manufacturing processes lead to exorbitant cost increases and significant amounts of sludge. An alternative method was developed in a pilot study which reduces water consumption by 90% through chemical rinsing and water reuse. The sulfuric acid pickle is regenerated and high purity metallic copper recovered through continuous electrolysis. Hydrogen peroxide-sulfuric acid was shown to be a superior substitute for the chromates and fluoride and nitric acid previously used to remove cupric oxide in the copper rods from which copper wire is produced. Total solids leaving the plant were reduced from 2500 lb/day to less than 100 lbs/day and metal losses from 600-700 lb/day to less than one lb. The estimated saving of the new process over conventional precipitation techniques is estimated at about \$2.61/ton of finished wire. A design for implementing the new process is included. (Schroeder-Wisconsin)  
W74-09244

## 6. WATER RESOURCES PLANNING

### 6A. Techniques Of Planning

PREDICTING THE HYDROLOGIC EFFECTS OF LAND MODIFICATIONS, Arizona Univ., Tucson. For primary bibliographic entry see Field 4A. W74-08753

DESIGN OF COST-EFFECTIVE WATER QUALITY SURVEILLANCE SYSTEMS, Raytheon Co., Portsmouth, R.I. Oceanographic and Environmental Services. For primary bibliographic entry see Field 5A. W74-08825

NON-EFFICIENCY OBJECTIVES AND DECISION-MAKING IN WATER RESOURCE DEVELOPMENTS, Massachusetts Univ., Amherst. Dept. of Agricultural and Food Economics. G. A. Vaut, and C. E. Willis. Water Resources Bulletin, Vol 9, No 6, p 1182-1187, 1973. 32 ref.

Descriptors: \*Cost-benefit theory, \*Regional development, Economic justification, Equity, Social values, Planning, Regional economics, Decision making, Management.  
Identifiers: Social preference function, Multi-objective planning.

Major's proposed inclusion of a regional development objective into traditional public investment benefit-cost analysis represents a basic attempt to implement multi-objective planning (See W70-05577). His approach is evaluated and methods to weigh alternative objectives are examined. In Major's model, weighted regional benefits and costs are added to the traditional national income assessment. The inclusion of a regional objective represents an attempt to include equity considerations into the decision process. It may not be accurate however, to assume that equity considerations are positively affected by water resource development projects. The nebulous regional benefit concept would best be replaced by an operational measure of equity. Measurement problems associated with Major's model are also discussed and three methods to weigh nonefficiency objectives are examined. In the explicit approach decision makers are interviewed directly; in the implicit approach coefficients are inferred from previous decisions; both approaches depend on the consistency and candor of the decision maker. A third method suggested allows the investigator to generate a variety of weights, utilizing sensitivity analysis to suggest the impact of changes in weights on investment decisions. A modified benefit-cost approach is suggested which explicitly includes equity consideration and utilizes a combination of three weighing approaches. (Schroeder-Wisconsin)  
W74-09084

#### 2 OBJECTIVES 4 ACCOUNTS.

Water Resources Council, Washington, D.C. For primary bibliographic entry see Field 6E. W74-09154

#### MARINE RESOURCES COUNCIL.

For primary bibliographic entry see Field 6E. W74-09170

### 6B. Evaluation Process

MODELING OF HYDROLOGIC PROCESSES AND WATER SALVAGE PROCEDURES IN SEMIARID REGIONS, Arizona Univ., Tucson. Water Resources Research Center. For primary bibliographic entry see Field 5D. W74-08702

PROCEDURES IN FORECASTING USE OF WATER RESOURCES (O METODIKE PROGNOZIROVANIYA ISPOL'ZOVANIYA VODNYKH RESURSOV), Akademiya Nauk SSSR, Moscow. Institut Vodykh Problem. D. A. Yeliseyev. Vodnyye Resursy, No 4, p 101-105, 1973.

Descriptors: Water resources development, \*Water utilization, \*Water conservation, \*Forecasting, \*Alternative planning, \*Water demand.  
Identifiers: \*USSR.

Qualitative and quantitative changes in the growth of the Soviet national economy during the last several decades have called for a new approach to the utilization of the country's water resources. Use of water resources and, accordingly, construction of large hydraulic installations in the 1920's and 1930's were geared to meet the requirements of hydroelectric power and navigation in European Russia or of agriculture in Soviet Central Asia. In the 1950's and 1960's, the scope of water-resources management increased considerably and today includes virtually all branches of the national economy. Steps required to prepare plans and forecasts for water-resources development and water conservation in the USSR are examined, and emphasis is placed on the need to select alternative plans for evaluation of rates and trends of development of the national economy on the whole and of water management in particular. (Josefson-USGS)  
W74-08706

#### THE LONG-TERM STRATEGY FOR WATER RESOURCES IN THE UK.

Water Services, Vol 78, No 936, p 41-43, February, 1974. 1 fig.

Descriptors: Publications, \*Water resources, \*Long-term planning, Project planning, Water resources development.  
Identifiers: \*United Kingdom.

A report by the Water Resources Board of England examines the water resources of England and Wales as a whole and makes recommendations to meet the expected increase in the demand for water up through the year 2000. Findings indicate that no more than five new strategic reservoirs need be built. The report also considers a wide range of possible strategies for the Dee Estuary area where the need for water cannot be met from local sources; a strategy based on a mixture of inland and estuary storage making use of rivers to carry water is recommended. The report is summarized in outline form with project and research recommendations listed. (Sandoski-FIRL)  
W74-08794

#### PROMOTING ENVIRONMENTAL QUALITY THROUGH URBAN PLANNING AND CONTROLS.

North Carolina Univ., Chapel Hill. Center for Urban and Regional Studies. For primary bibliographic entry see Field 5G. W74-08828

ENVIRONMENTAL IMPACT ANALYSIS: A REVIEW OF THREE METHODOLOGIES, Wisconsin Univ., Madison. Inst. for Environmental Studies. For primary bibliographic entry see Field 6G. W74-08839

EVALUATING WATER REUSE ALTERNATIVES IN WATER RESOURCES PLANNING, Utah State Univ., Logan. Center for Water Resources Research. For primary bibliographic entry see Field 5D. W74-08940

#### GEO THERMICS.

For primary bibliographic entry see Field 2F. W74-08973

# TECHNICAL-ECONOMIC ESTIMATION OF GEOTHERMAL RESOURCES,

Akademiya Nauk USSR, Kiev. Inst. of Technical Thermodynamics.

O. A. Kremnizov, V. J. Zhuravlenko, and A. V. Shurtshkov.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1688-1696, 1973. 13 fig, 2 tab, 7 ref.

Descriptors: \*Geothermal studies, Investigations, \*Hydrogeology, \*Aquifer testing, Drilling, Exploration, Hydrothermal studies, Borehole geophysics, Thermal water, Thermal power, Costs, Data collections, Hydrologic data. Identifiers: \*Geothermal power, \*USSR.

Tremendous underground heat resources and simplicity of geothermal installations attract ever more attention of power engineers in many countries. To determine conditions and possible scale of earth heat effective utilization it is necessary to compare thoroughly geothermal sources with other energy sources. With increasing depth the thermal water temperature rises as well as the heat output of the well. Non-linearity of the well cost dependence with depth predetermines an optimal depth at which the best technical-economic characteristics of the well as an energy source are achieved. Data on geothermal conditions, well yields, and the influence of the depth on basic economical characteristics of geothermal heat sources are presented. (See also W74-08973) (Knapp-USGS)  
W74-09044

# EFFICIENCY AND EQUITY IN AUGMENTING WATER SUPPLY,

California Univ., Santa Barbara. Dept. of Economics.  
L. J. Mercer, and W. D. Morgan.  
Available from the National Technical Information Service as PB-233 131, \$3.00 in paper copy, \$1.45 in microfiche. Completion Report, December 1973, California Water Resources Center, Davis, Project UCAL-WRC-W-345. 15 p, 2 fig, 4 tab, 4 ref. OWRR A-041-CAL(1).

Descriptors: \*Cost analysis, \*Mathematical models, \*Economic efficiency, Water supply, \*Equity, Investment model studies, \*Cost-benefit analysis, Taxes, Financing, \*California. Identifiers: Santa Barbara County(Calif), San Luis Obispo County(Calif), \*Water supply augmentation.

This study includes analysis of two issues in augmenting water supply: efficiency and equity. The efficiency analysis rests on an operational (computerized) benefit cost model developed to evaluate the optimal timing of investment for water supply augmentation. Benefits in this model are estimated by both an opportunity cost approach and a willingness to pay approach with both parallel shifts and rotating (around the initial intercept) shifts of the water demand curve which is estimated in a linear fashion. The equity portion of the study entails analysis of the geographical distribution of benefits relative to payments with alternative plans for financing the study project. Plans analyzed include: (a) full reliance on a uniform countywide property tax to cover the financial obligation incurred; and (b) a unit charge (long run financial or resource cost) to water districts for delivered water and a countywide property tax to meet any remaining obligation. Analysis of geographical equity under alternative financing plans indicates that full reliance on a countywide property tax would be the worst solution. A combination of long run unit charges (either financial or resource cost) for water delivered and a countywide property tax in the early years to cover the remaining financial obligation is a superior financing plan from the viewpoint of equity among geographic areas as well as efficiency. (Snyder-California, Davis)

W74-09051

# THE DEMOGRAPHIC, POLITICAL, AND ADMINISTRATIVE SETTING,

Florida Univ., Gainesville. Urban Studies Bureau.  
C. Feiss, R. McQuown, P. Roberts, and R. May.  
Available from the National Technical Information Service as PB-233 164, \$3.25 in paper copy, \$1.45 in microfiche. Rookery Bay Land Use Studies, Study No 1. Published by the Conservation Foundation, Washington, D.C., September 1973. 29 p, 1 fig, 8 tab, 13 ref. OWRR C-4022(No 9004)(2), C-1817(No 3170)(2) and C-2201(No 3385)(2).

Descriptors: \*Florida, \*Social aspects, \*Political aspects, \*Land use, Estuaries, Bays, Management, \*Human populations, \*Administration. Identifiers: \*Collier County(Fla), \*Rookery Bay(Fla).

The social, political and managerial issues impacting a mangrove-estuarine area in Collier County, Florida, relating to the development of land-use strategies to protect the area's natural sanctuary, Rookery Bay, are discussed. Population, employment, land ownership, government, planning machinery, citizen activities, political climate and development pressures of the area as they affect on the sanctuary are examined. Several alternative approaches for the future of the sanctuary are offered and recommendations are made for protective action.  
W74-09058

# HYDROGRAPHY AND BEACH DYNAMICS,

Rosenstiel School of Marine and Atmospheric Science, Miami, Fla.  
T. N. Lee, and B. J. Yokel.  
Available from the National Technical Information Service as PB-233 165, \$3.75 in paper copy, \$1.45 in microfiche. Rookery Bay Land Use Studies, Study No 4. Published by the Conservation Foundation, Washington, D.C., November 1973. 51 p, 12 fig, 9 tab, 8 ref. OWRR C-4022(No 9004)(3), C-1817(No 3170)(3) and C-2201(No 3385)(3).

Descriptors: \*Florida, Bays, Estuaries, Tides, Gulf of Mexico, \*Hydrograph analysis, \*Land use, \*Beaches. Identifiers: \*Rookery Bay(Fla), Beach dynamics.

Hydrologic and beach dynamics studies were conducted in and near Rookery Bay Sanctuary south of Naples on the southwest coast of Florida. These studies determined water exchange rates, tidal range variations, the characteristics of the tidal prism, bottom contours, the basin capacities and changes occurring in the geometry of the channels connecting the Sanctuary system with the Gulf of Mexico. Rookery Bay has an average depth of 3.0 feet, a mean volume of 135 million cubic feet and an effective mean tidal prism of 154 million cubic feet. The mean renewal rate for Rookery Bay was estimated at between one and ten days, with the best estimate being 3.2 days. Henderson Creek has an average depth of 2.5 feet, a mean volume of 41.5 million cubic feet and an effective mean tidal prism of 37.1 million cubic feet. The mean renewal rate for Henderson Creek was estimated at between one and six days with the best estimate being two days. Data on mean high tide levels at four stations for 23 months were presented. It was shown that long-term studies are needed to accurately determine mean high water level and that serious sources of error may result from short term studies. The changing configurations of Keewaydin and Little Marco Islands are illustrated and the implication for the Sanctuary discussed.  
W74-09059

# AN ANNOTATED BIBLIOGRAPHY FOR ECONOMIC EVALUATIONS OF THE

# AQUACULTURE OF SELECTED CRUSTACEANS AND MOLLUSKS,

California Univ., Davis. Dept. of Agricultural Economics.

For primary bibliographic entry see Field 10C.

W74-09067

# QUALITY OF LIFE IN KICKAPOO VALLEY COMMUNITIES,

Wisconsin Univ., Madison. Inst. for Environmental Studies.  
E. A. Wilkening, P. Wopat, J. G. Linn, C. Geisler, and D. McGranahan.  
Report 11, September 1973. 114 p, 7 fig, 58 tab, 1 append. NSF GI-29731.

Descriptors: \*Baseline studies, \*Economic impact, \*Social impact, \*Reservoirs, Social aspects, Recreation, Tourism, Flood control, Environmental effects, Wisconsin. Identifiers: \*Kickapoo River(Wis.), \*La Farge Dam(Wis.), Quality of life.

The Kickapoo River is the site of a proposed recreation and flood control reservoir in southwestern Wisconsin. This study sought to establish social and economic baseline information on communities to be affected prior to the project's completion. Information was gathered in 1972 primarily by a study of 12 communities—six within the project area and six outside the valley—by interviewing 18-23 leaders of each community. Additional data were collected from the U.S. Census Bureau and agency records. All six communities in the valley suffered declines in farm number, population, and cropland, which may have strongly influenced the desire for a permanent lake. Median income in the five county area ranges \$1777-\$3348 below the 1970 Wisconsin median of \$10,068. Respondents rated services in each community on a continuum from 'very poor' to 'very good.' Areas evaluated included industrial opportunities, schools, health and medical facilities, special programs for the underprivileged, water and waste systems, fire protection, flood protection, police, local business, transportation, housing, zoning adequacy, taxes, recreational facilities, and civic involvement. Majority of communities thought the dam would have some or a large effect but were uncertain as to the precise effect. The major benefit perceived was tourism, recreation, and new industries. (Schroeder-Wisconsin)  
W74-09068

# 1971 UMPQUA RIVER ESTUARY RESOURCE USE STUDY,

Oregon Fish Commission, Port Orford. Div. of Management and Research.  
T. Gaumer, D. Demory, and L. Osis.  
Available from the National Technical Information Service as COM-73-11645, June 1973. 26p, 6 fig, 15 tab. NO4-3-208-55 DACW 57-72-C-0138 NOAA N208-0073-72(N).

Descriptors: \*Fishing, \*Oregon, \*Recreation, \*Estuarine fisheries, Fish migration, Shellfish, Herrings, Commercial fishing, Fish harvest, Systematics. Identifiers: Umpqua River Estuary(Ore.).

In 1971 the Oregon Fish Commission instigated a comprehensive study of recreational use and users of 16 Oregon estuaries. Data collected on the Umpqua River Estuary, a 5712 acre bay containing 1531 acres of tideland and located 222 miles south of the Columbia River, are summarized. Interviews with 3985 boat, shore, and scuba users provided the basic data source, with additional commission reports providing commercial landings and values of fish and shellfish. Utilizing these data, maps identifying principal boat fishing areas, clam beds, eel grass beds, food production areas, fish feeding areas, fish migration routes and herring spawning areas were developed. Fish comprised 69 and 97% of boat anglers' and shore anglers' catches with striped bass and Pacific tomcod

## Field 6—WATER RESOURCES PLANNING

### Group 6B—Evaluation Process

respectively, representing the major catch for each category. Soft shell clams made up 100% of tideflat users' take. The estimated 196,300 total estuary catch represents 107,600 fish, 84,600 clams, and 4,100 crabs. Nearly 85% of anglers interviewed were Oregon residents, with 30% residents of Douglas county. Commercial landings of marine food fish and shellfish caught in the Umpqua River Estuary in 1971 totaled 333,376 pounds valued at \$60,791. Shad was the principal species landed. (Schroeder-Wisconsin)  
W74-09069

**ENVIRONMENTAL QUALITY, INCOME DISTRIBUTION, AND FACTOR MOBILITY: THE CONSEQUENCES OF LOCAL ACTION,**  
New Mexico Univ., Albuquerque. Dept. of Economics.  
G. C. Huffbauer.  
Journal of Economic Issues, Vol VII, No 2, p 323-335, 1973. 4 tab, 6 ref.

Descriptors: \*Environment, \*Social adjustment, \*Urban sociology, Local governments, Social mobility, Income distribution, Financing, Oregon, Community development, Economic impact.  
Identifiers: Boulder(Colo.).

The consequence of a local community's environmental improvement programs on the income level of landholders, capitalists, and laborers and the social expectations of its inhabitants is examined. A model assumes an open economy, a single output produced, using two factors—land and a composite variable input composed of labor and capital—a balanced governmental budget, and environmental problems amenable to local solutions. A modified Harberger system of eight equations is used to determine the percentage change in output and factor quantities and prices. Costs to restore the environment to a priori standard are assumed to be proportional to expenditures per unit of variable input consumed; and in the alternative are assumed to be dependent on the total outlay. The elasticities of product demand and variable supply are assumed (equal to 10) and the elasticity of substitution assumed unitary. An environmental program financed through land taxes will not affect community outputs, enlarges labor and capital stock, and generates a rise in total wages. Alternatively, a tax on the variable factor depends on the capitalists' and laborers' valuation of the benefits of the program. If benefits exceed the costs and output rents, total variable wage and community population will increase. If costs exceed benefits, population, landholder, and variable factor earnings will decline. (Schroeder-Wisconsin)  
W74-09070

**MULTINATIONALS NEED NEW ENVIRONMENTAL STRATEGIES,**  
Denver Research Inst., Colo. Industrial Economics Div.  
J. G. Welles.  
Columbia Journal of World Business, Vol 8, No 2, p 11-18, 1973. 7 ref.

Descriptors: \*Environment, \*Management, \*Industries, \*Control, Social impact, Limiting factors, Recycling, Costs, Political aspects, Governmental interrelations, Trade associations.  
Identifiers: Multinational companies, Global pollution control, Corporate responsibility, Pollution havens.

Three questions are examined based on a 1972 survey of environmental strategies gathered from 130 interviews of multinational firms' representatives, industrial trade associations, and financial institutions. The first question keys on ways to inject an environmental dimension into management decisions of multinationals. Methods discussed include the creation of corporate environmental managers, environmental site selection analysis, material balance analysis, and corporate environmental impact statements. Also discussed are changing

managerial attitudes on the implication of environmental degradation by industry. The second question examines the responses of multinationals to 'pollution havens' in underdeveloped countries. Responses showed that only the highest polluting industries or those whose further expansions are blocked in their present location are likely to be attracted to 'pollution havens' and then with indeterminate benefits. The third question examines the multinationals' ability to stimulate more uniformity in pollution controls among nations and the resultant advantages. Aggressive cooperation between trade associations and government is asserted to be the best strategy to accomplish globally uniform controls. (Schroeder-Wisconsin)  
W74-09071

**A STOCHASTIC INVESTMENT MODEL FOR A SURVIVAL CONSCIOUS FIRM APPLIED TO SHRIMP FISHING,**  
Houston Univ., Texas.  
R. G. Thompson, M. D. George, R. J. Callen, and L. C. Wolken.  
Applied Economics, Vol 5, No 2, p 75-87, 1973. 6 tab, 12 ref.

Descriptors: \*Decision making, \*Commercial fishing, Marine fisheries, Shrimp, Texas, Risk, Capital supply, Economic justification, Mathematical models.  
Identifiers: Texas Gulf Coast.

From observation that the growth in capacity of fishing firms on the Texas Gulf Coast has been less rapid than maximizing net worth subject to capital rationing would suggest, a stochastic capacity expansion model for a survival conscious firm is developed. In the model, the firm maximizes expected net worth at the end of a planning period, subject to the constraint that there is no (probability) chance for bankruptcy to occur. The control variable in the model is capacity units purchased for the planning period. The model is also compared to the simple maximization model. Under the latter, bankruptcy is not an unlikely result. The application of the survivor model to the shrimp fishing industry appears to justify the modest industry growth in periods of expected favorable returns. Two limitations are noted: First, the model assumes survival is paramount and may not be applicable when survival is not a primary consideration; also, the limitation of the constant marginal utility of income assumption. (Schroeder-Wisconsin)  
W74-09072

**DYNAMIC ECONOMIC MANAGEMENT OF MIGRATORY WATERFOWL,**  
G. M. Brown, Jr., and J. Hammack.  
The Review of Economics and Statistics, Vol LV, No 1, p 73-82, 1973. 2 fig, 1 tab, 15 ref, 1 append.

Descriptors: \*Mathematical models, \*Waterfowl, \*Management, Optimization, Wetlands, Hunting, Value, Ponds, Canada, United States, Costs, Benefits, Game birds, Welfare(Economics).

A model to estimate transient and steady-state conditions necessary to achieve a social optimum in the allocation of resources for waterfowl production is developed. Essential components of the model include a hunter net valuation equation assuming the value of bagged waterfowl is a function of income, number previously bagged, seasons hunted, and hunting cost. Cost functions to produce additional birds utilizing ponds and a waterfowl production function are also estimated. The model seeks to maximize the present value of net income stream through manipulation of two variables: number of waterfowl bagged, and number of ponds utilized. First order requirements assert the best stock level equates the natural resource (waterfowl) marginal growth rate with the discount rate. Two biological production functions, a multiplicative form and a modified Beverton and Holt relationship having a constant return

scale are used to activate the model. Hunters' valuation was assumed to equal the compensating variation of consumer surplus. A 1969 survey of 5000 hunters in the Pacific Flyway was used to estimate the relationship. Optimal value from the model's assumption of pond costs of either \$12 or \$17 show 9.5-17.2 million breeders required instead of the existing 7.8 and from 2.0-7.5 million ponds contrasting the existing 1.3. (Schroeder-Wisconsin)  
W74-09073

**DEVELOPING A STATE WATER PLAN—MUDDY CREEK DAM AND RESERVOIR, EMERY COUNTY, FEASIBILITY STUDY,**  
Rollins, Brown and Gunnell, Inc., Provo, Utah.  
Available from the National Technical Information Service as COM-73-10385 \$3.00 in paper copy, \$1.45 in microfiche. Four Corners Regional Commission, Farmington, N.M. Report FCRC-TA-401-505-063, August 1971, 59 p, 18 fig, 13 tab.

Descriptors: \*Feasibility studies, \*Reservoirs, \*Economic efficiency, Capital costs, Operating costs, Cost-benefit analysis, Utah, Irrigation, Design, Land classification, Land use, Land tenure, Water rights, Surface water availability, Groundwater availability, Recreation, Water pollution control, Flood protection, Sedimentation, Colorado River Basin, Agriculture.  
Identifiers: \*Muddy Creek Reservoir(Utah).

The feasibility of a proposed dam on Muddy Creek located in southeastern Utah is examined. The creek is in the Dirty Devil River Basin, a portion of the Upper Colorado River Basin. Land in the project area is used primarily for the production of small grains, corn, alfalfa, and pasture for livestock, with a total of 8066 irrigated acres. A variety of data including distribution of crops, yields, land ownership, land classification, surface water supply ground water supply and water rights are discussed. The proposed reservoir will be a multipurpose facility including but not limited to irrigation, fish and wildlife, recreation and water pollution control. Construction design elements include a rolled earth and rock fill dam, outlet works, diversion and division structures, and a spillway. Total reservoir capacity inclusive of dead storage is expected to be 12,000 acre feet. The 50-year volume of sediment contained in the reservoir is projected to be 3200 acre feet. Total cost of construction is estimated at nearly \$1,600,000. The combined direct benefits and repayment capacity of the project are shown to exceed \$45,000 annually. (Schroeder-Wisconsin)  
W74-09075

**IN-PROCESS POLLUTION ABATEMENT: UP-GRADING METAL-FINISHING FACILITIES TO REDUCE POLLUTION,**  
Oxy Metal Finishing Corp., Madison Heights, Mich., Environmental Services Group.  
For primary bibliographic entry see Field 5G.  
W74-09080

**A TEST OF COMBINATIONS OF MODELS FOR PROJECTING THE POPULATION OF MINOR CIVIL DIVISIONS,**  
Rutgers - The State Univ., New Brunswick, N.J.  
M. R. Greenberg.  
Economic Geography, Vol 48, No 2, p 179-188, 1972. 1 fig, 3 tab, 46 ref. OWRRC-1629(3147) (6). 14-31-0001-3147.

Descriptors: \*Forecasting, \*Human population, \*Spatial distribution, Planning, Social mobility, Growth rates, Cities, Suburban areas, Monte Carlo method, Regions, \*Population, Projections.  
Identifiers: \*New York Metropolitan Region, Distributional factors, Municipalities.

Several methods to project population distributions and growth in minor governmental subdivisions are examined. Each method seeks to include

## Cost Allocation, Cost Sharing, Pricing/Repayment—Group 6C

historical-behavioral changes which anticipate alterations in observed growth and distributions, at different spatial levels, and to minimize errors resulting from multiple assumptions. Population projections for 567 municipalities in the New York Metropolitan Region through 1985 are examined. The interdependencies and importance of zoning ordinances, property taxes, fertility levels, and transportation patterns are considered. Three projection methods are illustrated. A random sample of 10% of communities in the region over a five year period was conducted to illustrate how direct projections of minor governmental units' populations are made. These projections were developed assuming a geometric growth rate, a logistic rate, and a form developed by Newling. Alternatively, population projections were made by extrapolating from national projections. It was found that this ratio method was fruitful only if a number of behavioral trends could be inserted at varying spatial levels. A third approach first allocated national projections and then utilized direct projections to adjust the former. This method was found the most accurate and the most costly. The choice of projection methods depends on the willingness of the researcher to trade-off cost for accuracy. (Schroeder-Wisconsin)

W74-09081

#### A COST ANALYSIS OF WASTE MANAGEMENT IN THE STEEL INDUSTRY,

Environmental Protection Agency, Washington, D.C. Office of Research and Monitoring. D. P. Tihansky. Journal of the Air Pollution Control Association, Vol 22, No 5, p 335-341, 1972. FWPCA 5-FI-WP-26,285-02.

Descriptors: \*Pollution abatement, \*Cost analysis, \*Mineral industry, Industrial wastes, Capital costs, Operating costs, Waste treatment, Maintenance costs, Water pollution control, \*Steel, Industries, Economics.

Three levels of pollution abatement costs in steel-making are examined. First, the overall costs to the industry are estimated for a 21-year period. Since 1951, U.S. steel corporations have expended \$1.2 billion for air and water pollution abatement facilities. Current annual operating costs for gaseous and liquid waste reduction total an additional \$70 million each. Pollution costs are shown to vary with the age of steel plants. Modernization, for example, can lead to improved pollution control through greater efficiency and economy in the use of resource inputs. A second level explores the abatement costs for a specific American steel company. This company expended \$8 million for abatement equipment during the 1951-1967 period. Operating expenses added an additional \$750,000. Capital and operating costs are separated for air and water pollution abatement for the firm and the industry. The final level explored provides cost estimates of air and water pollution controls for typical steel production stages. Departments examined include the coke plant, blast furnaces, basic oxygen furnaces, blooming mill, sheet mill, continuous pickling, tube mill, and coupling, over the 1951-67 period. (Schroeder-Wisconsin)

W74-09082

#### TOWARD A BETTER UNDERSTANDING OF RECREATIONAL BOATING IN THE ADIRONDACK LAKES REGION,

Northeastern Forest Experiment Station, Syracuse, N.Y. Recreation Research Unit. H. E. Echelberger, and G. H. Moeller. Water Resources Bulletin, Vol 9, No 6, p 1266-1271, 1973. 1 fig, 3 tab, 6 ref.

Descriptors: \*Lakes, \*Recreation, \*Boating, Physical properties, Boat-launching ramps, New York, Management, Control, Correlation analysis. Identifiers: \*Adirondack lakes.

The relationship between lake characteristics and varying peak period boat use on the Adirondack lakes is explored to aid recreational management decisions. The 14 lakes ranging in size from 851 to 6976 acres are located in the New York Adirondack Forest Preserve. Data were collected on four warm sunny weekend afternoons at three half-hour intervals, a time considered to represent the peak period. Holiday weekends were excluded. Boat counts were made by aerial observations on 12 lakes with surface counts for the remaining two. Boat user counts were averaged to determine the average peak use by lake. A number of variables including accessibility, lake configuration, commercial lodging accommodations, traffic volume, proximity of the lakes, launching facilities, and boat slips were hypothesized as having influence on peak user rates. To estimate the relationship, factor analysis was used to reduce the number of variables that were functionally related followed by stepwise regression. Results indicate that 69% of the variation in peak usage is accounted for by the number of launching facilities with accommodation boat slips; lake size and shoreline also affect usage. Accessibility, landscape quality, traffic volume, and availability of other lakes were found to be unrelated to usage. (Schroeder-Wisconsin)

W74-09083

#### 1971 TILLAMOOK BAY RESOURCE USE STUDY,

Oregon Fish Commission, Port Orford. Div. of Management and Research. T. Gaumer, D. Demory, and L. Osis. Available from National Technical Information Service as COM-73-11688. August 1973. 28 p, 7 fig, 15 tab. DACW 57-72-C-0138, NOAA N208-0073-72(N) and NO4-3-208-55.

Descriptors: \*Oregon, \*Recreation, \*Estuarine fisheries, Fishing, Shellfish, Fish, Commercial fishing, Systematics, Fish harvest. Identifiers: \*Tillamook Bay(Ore).

The Oregon Fish Commission initiated a comprehensive study of recreational users and uses of 16 Oregon estuaries in 1971. Data collected on Tillamook Bay, the third largest bay in the state encompassing 4163 acres of tidelands are summarized. Interviews with 15,700 boat and shore anglers, tideflat users, and scuba divers provided much of the data, with additional commission reports providing information on commercial landings and values of fish and shellfish. From this information, maps identifying principal boat fishing areas, clam beds, eel grass beds, commercial oyster leases and potential growing areas, fish feeding areas, migration routes, and herring spawning areas were generated. Dungeness crabs and chinook salmon accounted for 96% of the boat anglers' catch; 17,500 shore angler trips were also expended with 52% of their activity concentrated on the bay's north jetty. Pile perch and kelp greenling represented the principal species taken by this group. Of the 24,500 tideflat user trips, 98% were expended for clam digging. Nearly 73% of the bay users were Oregon residents, 21% were Tillamook County residents, and 6% were nonresidents. Commercial landings of marine food fish and shellfish caught in 1971 totaled 343,130 pounds valued at \$300,009. Oyster was the principal species harvested. (Schroeder-Wisconsin)

W74-09085

#### 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

#### MODELING OF HYDROLOGIC PROCESSES AND WATER SALVAGE PROCEDURES IN SEMIARID REGIONS,

Arizona Univ., Tucson. Water Resources Research Center. For primary bibliographic entry see Field 5D.

W74-08702

#### TURNKEY CONTRACTS FOR SEWAGE TREATMENT PLANTS,

For primary bibliographic entry see Field 5D. W74-08786

#### ANALYSIS OF POLLUTION CONTROL COSTS,

Baker (Michael), Jr., Inc., Beaver, Pa. For primary bibliographic entry see Field 5G. W74-08829

#### PHOSPHORUS REMOVAL COSTS,

For primary bibliographic entry see Field 5D. W74-08855

#### A PLANNED MAINTENANCE MANAGEMENT SYSTEM FOR MUNICIPAL WASTEWATER TREATMENT PLANTS,

EnviroPlan, Inc., College Park, Md. Fairfax County, Va. For primary bibliographic entry see Field 5D. W74-08944

#### SULFURIC ACID AND FERROUS SULFATE RECOVERY FROM WASTE PICKLE LIQUOR,

Fitzsimons Steel Co., Youngstown, Ohio. For primary bibliographic entry see Field 5D. W74-08945

#### THE ECONOMICS OF THE SMALL GEOTHERMAL POWER STATION,

Department of Scientific and Industrial Research, Wairakei (New Zealand). Chemistry Div. R. James.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1697-1704, 1973. 6 fig, 14 ref.

Descriptors: \*Thermal power, \*Geothermal studies, \*Electric power costs, Economics of scale, Costs, Income, Prices.

Identifiers: \*Geothermal power, \*New Zealand.

A geothermal borehole, Tauhara No. 1, near Taupo, New Zealand, was investigated for the economics of generation of electrical energy and for the industrial application of the large amount of heat energy usually wasted in the rejected bore water. A power plant of 10 MW(e) could be erected for about 1.14 million dollars (N.Z.) at a generating cost of about 0.2 cents/kWh(e), which is a very attractive figure. The specific cost per kilowatt of small plants could be as cheap as that of very large plants, in other words, the 'scale effect' does not apply for geothermal power in New Zealand. An enormous volume of hot fluids is rejected at large geothermal projects such as that at Wairakei. The heat energy, if sold at even half the price of that produced by coal-fired boilers, would realize about 6 million dollars per year. (See also W74-08973) (Knapp-USGS)

W74-09045

#### ECONOMICS OF THE GEYSERS GEOTHERMAL FIELD, CALIFORNIA,

Thermal Power Co., San Francisco, Calif. D. A. McMillan, Jr.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1705-1714, 1973. 5 fig, 1 tab, 56 ref.

Descriptors: \*Thermal power, \*Geothermal studies, \*Electric power costs, \*California, Economics of scale, Costs, Income, Prices. Identifiers: \*Geothermal power, \*Geysers field(Calif).

The economics of The Geysers geothermal field located approximately 75 miles north of San Fran-

## Field 6—WATER RESOURCES PLANNING

### Group 6C—Cost Allocation, Cost Sharing, Pricing/Repayment

cisco, California, is discussed. At plant use conditions The Geysers geothermal field produces a dry, slightly superheated steam of which about 0.5% are non-condensable gases. The cost of the geothermal energy at The Geysers is lower than \$0.005 per kWh produced. This cost is calculated on the basis of the actual price of the steam \$0.0026. The average cost of conventional thermal and atomic electrical power in California is around \$0.007 per kWh. The corrosion, incrustation, and waste water disposal problems are under easy control in The Geysers field. The conservative cost of \$0.005 per kWh is inclusive of those expenses. (See also W74-08973) (Knapp-USGS) W74-09046

**ECONOMICS OF GEOTHERMAL ELECTRIC POWER GENERATION AT MATSUKAWA,** Japan Metals and Chemicals Co. Ltd., Tokyo. Exploitation Dept. S. Nakamura. In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1715-1716, 1973.

Descriptors: \*Thermal power, \*Geothermal studies, \*Electric power costs, Economics of scale, Costs, Income, Prices. Identifiers: \*Geothermal power, \*Japan(Matsukawa).

The economics of geothermal power at a site in the Matsukawa area of the Iwate Prefecture, Japan, is discussed. The total expenditure for surveys and research came to approximately yen 160,000,000. During the approximately 6-year survey period, the major part of this expenditure was for five test borings. Six steam wells were drilled to depths of 1000 to 1500 meters at a cost of yen 439,000,000. Compared with costs in Italy, New Zealand, and the United States, this figure is rather high. However, this is the first such development project in Japan, and so, in addition to the lack of precedent, there were problems concerning drilling technology and machinery. Total cost of constructing the 20,000 kW plant (including interest and all connected costs) was yen 2,057,000,000. Construction cost per kW was yen 102,850, about 1.5 to 2.0 times that for domestic thermal power generation plants. At yen 2.63/kWh, the present cost of generation is on a level with that of thermal power. However, the fuel supply is inexhaustible, and there is no expenditure for the fuel. (See also W74-08973) (Knapp-USGS) W74-09047

**WAIRAKEI POWER STATION NEW ZEALAND—ECONOMIC FACTORS OF DEVELOPMENT AND OPERATION,** Ministry of Works, Wellington (New Zealand). J. H. Smith, and G. R. McKenzie. In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1717-1723, 1973. 6 tab, 8 ref.

Descriptors: \*Thermal power, \*Geothermal studies, \*Electric power costs, Economics of scale, Costs, Income, Prices. Identifiers: \*Geothermal power, New Zealand.

The Wairakei geothermal power station, New Zealand, is described in terms of its technical characteristics, installation costs and maintenance costs. Cost of NZ \$225.37 per kilowatt installed is based on the total installed capacity of 192.6 MW. (See also W74-08973) (Knapp-USGS) W74-09048

**ON TAXATION AS A POLLUTION CONTROL POLICY,** Pittsburgh Univ., Pa. Graduate School of Business.

For primary bibliographic entry see Field 5G. W74-09049

**2 OBJECTIVES 4 ACCOUNTS,** Water Resources Council, Washington, D.C. For primary bibliographic entry see Field 6E. W74-09154

**FAILURE OF BRIBES AND STANDARDS FOR POLLUTION ABATEMENT,** Resources for the Future, Inc., Washington, D.C. For primary bibliographic entry see Field 5G. W74-09240

**BRIBES AND CHARGES IN POLLUTION CONTROL: AN ASPECT OF THE COASE CONTROVERSY,** Resources for the Future, Inc., Washington, D.C. For primary bibliographic entry see Field 5G. W74-09241

**THE ECONOMICS OF ENVIRONMENTAL QUALITY MEASUREMENT,** Ecology Audits, Inc., Dallas, Tex. For primary bibliographic entry see Field 5G. W74-09243

**POLLUTION ABATEMENT IN A COPPER WIRE MILL,** Environmental Protection Agency, Washington, D.C. Div. of Technology Transfer. For primary bibliographic entry see Field 5G. W74-09244

### 6D. Water Demand

**PROCEDURES IN FORECASTING USE OF WATER RESOURCES (O METODIKE PROGNOZIROVANIYA ISPOL'ZOVANIYA VODNYKH RESURSOV),** Akademiya Nauk SSSR, Moscow. Institut Vodnykh Problem. For primary bibliographic entry see Field 6B. W74-08706

**PROCEDURAL PROBLEMS IN PROJECTED PLANNING OF WATER CONSUMPTION AND DIVERSION BY INDUSTRY IN THE USSR (METODICHESKIYE VOPROSY RASCHETA VODOPOTREBLENIYA I VODOOTVEDENIYA V PROMYSHLENNOSTI SSSR NA PERSPEKTIVU),** Akademiya Nauk SSSR, Moscow. Institut Vodnykh Problem. For primary bibliographic entry see Field 3E. W74-08710

**AGRICULTURAL DEMAND FOR WATER IN THE PECOS RIVER BASIN: AN ADDENDUM,** New Mexico Univ., Albuquerque. Dept. of Economics. For primary bibliographic entry see Field 3F. W74-08756

**THE LONG-TERM STRATEGY FOR WATER RESOURCES IN THE UK,** For primary bibliographic entry see Field 6B. W74-08794

**TRENT-WITHAM-ANCHOLME SCHEME AND PROJECT OF THE LINCOLNSHIRE RIVER AUTHORITY,** Lincolnshire River Authority (England). Water Resources Dept. For primary bibliographic entry see Field 6E. W74-08882

**MEETING WATER DEMANDS IN THE CHINO-RIVERSIDE AREA,** California State Dept. of Water Resources, Sacramento. C. R. White. Bulletin No 104-3, May 1971. 27 p, 20 fig, 3 tab.

Descriptors: \*Water supply, \*Groundwater, \*Planning, \*California, Alternate planning, Economic impact, Land use, Surface water, Water sources, Value, Water management(Applied), Imported water, Water storage. Identifiers: \*Southern California, Chino-Riverside area(Calif.).

The California Chino-Riverside area occupies 641 square miles throughout portions of Riverside, San Bernardino and Los Angeles counties. The 1965 water demand for the area was approximately 450,000 acre-feet; it is estimated to reach 850,000 by 2015. To meet this projected demand an investigation of alternative supply sources was conducted. Nearly 12 million acre-feet of water is stored in ground water basins in the area, which is replenished at an annual average of 394,000 acre-feet. Current ground water extraction accounts for 70% of the demand with imported water from the Bunker Hill-San Timoteo Basin and the Colorado River covering 18% and 6% of the total. Four plans to meet future demand are considered. First, a maximum amount of imported water for artificial recharge while using ground water for demand. Plan 2 also maximizes imported water for direct delivery while reducing ground water pumping. Both plans would increase ground water storage by 2015. Plan 3 uses a maximum of ground water without depleting the last 50 feet. Plan 4 would stabilize existing water levels, supplementing pumping with imported water. Water sources, water quality, and costs were estimated for each plan. The least expensive alternatives are 1, 3, 4 and 2, respectively. (Schroeder-Wisconsin) W74-09076

**MEETING WATER DEMANDS IN THE RAYMOND BASIN AREA,** California State Dept. of Water Resources, Sacramento. Y. Higashi. Bulletin No 104-6, June 1971. 54 p, 29 fig, 15 tab, 13 ref.

Descriptors: \*Water demand, \*Groundwater availability, \*Conjunctive use, \*Alternate planning, Geohydrology, Legal aspects, Safe yield, Water quality, Water spreading, Water costs, Water distribution(Applied), Imported water, Watershed management, Water supply, California, Watersheds(Basins). Identifiers: Raymond Basin(Calif.).

A three phase investigation examining the geology, hydrology and operation-economics was conducted to provide local agencies in the Raymond Basin area information on a wide range of alternative combinations of water supply sources and facilities. The basin is located immediately northeast of Los Angeles. The first two phases of the investigation yielded data on local availability of water supplies, water quality, and information on the characteristics of the basin. A mathematical model was also developed to simulate future water level fluctuations in the basin. Demand is expected to grow from 52,000 acre-feet in 1970 to 70,000 in 2020. The ground water is identified as one of the most significant sources of water; in 1970, nearly one million acre-feet was stored in the basin. Net future replenishment under mean hydrologic conditions is estimated at 24,600 acre-feet. Four plans are examined to meet future demands. These plans vary from relying exclusively upon the basin's ground water to the exclusive use of imported water. Facilities, costs and resultant ground water levels are explored for each plan. (Schroeder-Wisconsin) W74-09077

**THE UPPER HUDSON WHITEWATER OR WASHWATER,**  
L. Pringle.  
Audubon, Vol 73, No 2, p 88-100, March 1971. 1 map, 1 photo.

Descriptors: \*Hudson River, \*New York, Dams, \*Dam sites, \*Water distribution, \*Water demand, \*Environmental effects, Flow, Flow control, Measurement, Instrumentation, Water costs, Water delivery, Water management (Applied), Water purification, Reservoir storage, Desalination, Water shortage, Wildlife, Habitats, Wildlife conservation, Balance of nature, Recreation.  
Identifiers: Whitewater canoeing.

Increased water demands by New York City have spawned the idea of constructing a dam on the Upper Hudson River. Conservationists have studied the probable effects on the Adirondack Forest Preserve. These effects include destruction of unbroken forests as well as the habitat of many Adirondack animals. Also destroyed would be scores of rapids, which provide whitewater canoeing for people in the Northeast. Alternatives to the dam construction involve better use and reuse of New York's existing water supplies. Metering and revision of free schedules which favor heavy users would help reduce demand on such supplies. In addition, millions of gallons of water could be saved by eliminating wastes in plumbing facilities. While conservationists argue for recycling of water, some water engineers contend that present facilities are inadequate to remove some viruses and other pathogens. Desalination plants are another alternative, but the largest plant in operation, located in Key West, Florida, produces 2.6 million gallons of fresh water per day, compared with New York's approximate consumption of over 2 billion gallons per day. (Ritchie-Florida)  
W74-09137

**PUBLIC RESPONSE TO DESALTED SEA WATER,**  
California Univ., Berkeley. School of Public Health.  
M. C. Chew, R. N. Mitchell, and W. H. Bruvold.  
Journal of the American Water Works Association, Vol 66, No 1, p 8-13, January 1974. 3 illus, 2 photo, 4 tab, 9 ref.

Descriptors: \*Desalination plants, \*Water resources development, Desalination, Ground-water, California, Surveys, Saline water intrusion.

In a recently conducted state-wide survey in California, seventy-five percent of the respondents were unconvinced of whether a water shortage exists in the state, and a plurality expressed a preference for desalinated ocean water to supplement existing water supplies. The interviews were comprised of four sections. The first dealt with existing sources of supply and the adequacy of these supplies for the next fifteen years. The second dealt with the quality of the water currently being delivered to the respondents' homes. The third dealt with the use of desalted water in the respondents' homes, and the last dealt with the necessity of using desalted water in the community and the ways of making this matter known to responsible governmental bodies. Respondents were also questioned as to the advantages and disadvantages they perceived in the use of desalted water. An advantage frequently seen was that the use of desalted water would preserve ground-water levels, combat salt water intrusion, and allow reservoirs to be kept full for recreation. Disadvantages mentioned were the lack of minerals and fluorides and possible nuclear contamination. (Ritchie-Florida)  
W74-09171

**PROSPECTIVE COSTS OF ADJUSTING TO A DECLINING WATER SUPPLY: TEXAS HIGH PLAINS,**  
Economic Research Service, (USDA), Washington, D.C.

W. L. Harman, W. F. Hughes, and J. R. Martin.  
Texas AES, Dept. of Agricultural Economics and Sociology, Departmental Technical Report No. 71-3, March 1971. 29 p, 1 fig, 3 tab, 5 ref.

Descriptors: \*Agriculture, \*Water supply, \*Irrigation, \*Income, \*Efficiencies, Farm prices, Farm units, Water requirements, Dry farming, Land use, Texas, Linear programming.  
Identifiers: \*Texas High Plains.

The effects of declining water supplies combined with the growing cost-price squeeze had led to declining income on irrigated farms of the Texas High Plains. While a number of alternatives to maintain income have been assessed, increased farm size appears to be the most promising source of relief. A multiperiod linear programming model is developed to determine minimum starting capital and the subsequent farm size adjustment necessary to obtain and maintain a disposable annual income of \$7500, given three water supply situations—good, fair, and poor. The programming models generate capital flow, water use, ownership strategies and farm size changes as farm operations shift from irrigated to dryland farming. An essential requirement to accomplish the adjustment is the ability to generate substantial amounts of internal capital, while maintaining the minimum standard of life. Using 1966 prices, the poor and fair water supplies states are insufficient to generate adequate returns to absorb declining land values and maintain \$7500 consumptive levels. For the study area, only 30% of the 6.9 million acres can be converted to dryland farming without sacrificing living standards or net worth. (Schroeder-Wisconsin)  
W74-09242

## 6E. Water Law and Institutions

**PROSPECTS OF SCIENTIFIC AND TECHNICAL COOPERATION BETWEEN THE USSR AND THE UNITED STATES IN THE USE OF WATER RESOURCES (PERSPEKTIVY NAUCHNO-TEKHNIЧЕСКОГО СОТРУДНИЧЕСТВА МЕЖДУ СССР И США В ОБЛАСТИ ИСПОЛ'ЗОВАНИЯ ВОДНЫХ РЕСУРСОВ),**  
I. I. Borodavchenko, and Ye I. Serdyuk.  
Vodnyye Resursy, No 4, p 193-196, 1973.

Descriptors: \*Water resources development, \*Water utilization, \*Coordination, \*Information exchange, \*United States, Governments, Institutions, Planning, Programs, Projects.  
Identifiers: \*USSR, \*International cooperation.

Forms of agreement on scientific and technical cooperative efforts of the USSR and the United States in the field of utilization of water resources are examined. Activities of the Soviet-American commission on scientific and technical cooperation and of Soviet-American working groups of specialists engaged in drafting specific proposals on cooperative programs are discussed. Basic problems necessitating coordinated efforts on the part of the two countries are outlined. (Josefson-USGS)  
W74-08703

**SANITARY IMPLICATIONS OF SMALL BOAT POLLUTION IN AN ATLANTIC ESTUARY,**  
Adelphi Univ., Garden City, N.Y. Inst. of Marine Science.  
For primary bibliographic entry see Field 5G.  
W74-08771

**CRITIQUE OF WATER POLLUTION CONTROL ACT,**  
British Columbia Univ., (Vancouver). Westwater Research Centre.  
For primary bibliographic entry see Field 5G.  
W74-08774

**ENVIRONMENTAL MANAGEMENT AND LOCAL GOVERNMENT,**  
International City Management Association, Washington, D.C.  
S. Carter, M. Frost, C. Rubin, and L. Sumek.  
Copy Available from GPO Sup Doc as EPI.23-600/5-73-016, \$3.80; microfiche from NIS as PB-232 955, \$1.45. Environmental Protection Agency, Socioeconomic Studies Series, Report EPA-600/5-73-016, February 1974. 390 p, 126 tab, 26 ref. EPA Program Element 1HA097, R-801374.

Descriptors: \*Surveys, \*Environmental control, \*Management, \*Local governments, Cities, Attitudes, Water quality standards, Taxes, \*Institutional constraints, \*Water policy, Pollution taxes (Charges), Legal aspects.  
Identifiers: \*Environmental impact.

Results are presented of a study of environmental management and local government. The study has two main components: (1) a survey of chief executives in cities over 10,000 population and counties over 50,000; and, (2) a series of field studies of local environmental management in Dallas, Texas; Inglewood, California; Miamisburg, Ohio; and the Piedmont Triad Region (Forsyth and Guilford Counties), North Carolina. The major topics include: perception of the definition of environment, priority of environment as a local policy issue, and types of environmental problems facing each local government; adoption of local policy statement on the environment; existence of citizen environmental boards, environmental agencies, environmental sections in master plans, land use controls, other environmental controls, moratoria, environmental quality standards, environmental impact assessment procedures, environmental law suits, tax incentives and penalty charges; factors contributing to and factors creating obstacles to development of environmental programs; and, relations with state and federal agencies. (EPA)  
W74-08827

**THE ARCHAEOLOGICAL RESOURCES OF THE SALMON RIVER CANYON, A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS,**  
Idaho Univ., Moscow. Water Resources Research Inst.  
E. H. Swanson, Jr.  
August 1970. 20 p, 1 fig, 33 ref. OWRR Project B-014-IDA(4).

Descriptors: \*History, Federal project policy, \*River basins, \*Evaluation, Human populations, Project planning, Project purposes, \*Idaho, Canyons, Glaciers, Environmental effects.  
Identifiers: \*Archaeology, \*Salmon River, \*Wild and scenic rivers, Glacial climates.

The nature and significance of the archaeological resources of the Salmon River Canyon of Idaho are reviewed and discussed as part of a current project of developing criteria for classification of rivers prior to their inclusion into the National Wild and Scenic Rivers System. Archaeologically the canyon has scientific and historic importance because of the evidences of 2 important prehistoric Indian cultures who occupied the area and the fact that the Salmon is a proglacial river whose terraces reflect glacial history, which in combination with evidences of early man should reflect man's relationship to the glacial history of the region. The historic inhabitants were Northern Shoshoni and Nez Perce groups who represented 2 major linguistic groups. Current evidence indicates that the area was not inhabited prior to major environmental changes 8000-8500 years ago. The significance of many archaeological sites are discussed. Archaeological sites are nonrenewable scientific and historic resources and therefore have intrinsic value which the federal government has been slow to recognize. Only a very small fraction of archaeological resources in the Columbia Basin have been explored because the government

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requires considerable justification for such projects, but does not require justification for exploitive projects such as dams. (Casey-Arizona)  
W74-08845

**PHOSPHORUS REMOVAL DESIGN SEMINAR, CONFERENCE PROCEEDINGS NO. 1.**  
Environmental Protection Service, Ottawa (Ontario).  
For primary bibliographic entry see Field 5D.  
W74-08846

**LAND APPLICATION OF PROCESSED ORGANIC WASTES.**  
Ministry of the Environment, Toronto (Ontario).  
Waste Management Branch.  
For primary bibliographic entry see Field 5D.  
W74-08862

**A TANNER LOOKS AT THE FEDERAL WATER POLLUTION CONTROL ACT AMENDMENTS OF 1972.**  
Widen (R. J.) Co., North Adams, Mass.  
For primary bibliographic entry see Field 5G.  
W74-08863

**TRENT-WITHAM-ANCHOLME SCHEME AND PROJECT OF THE LINCOLNSHIRE RIVER AUTHORITY.**  
Lincolnshire River Authority (England). Water Resources Dept.  
H. S. Hawkins, and J. D. Arrowsmith.  
The Public Health Engineer, No 6, p 255-272, November 1973. 7 fig, 2 tab.

Descriptors: \*Water resources, \*Water demand, \*River training, \*Control systems, Instrumentation, Pipelines, Design criteria, Reservoirs, Outlets, Pumping plants, Chlorination, \*Water quality, Organizations.  
Identifiers: \*United Kingdom(Lincolnshire).

The organization and establishment of the Lincolnshire River Authority (LRA) is described. River authorities such as this were established under the Water Resources Act of 1963 to continue the function of land drainage and pollution control. A discussion of seven years' progress of the LRA is given. This includes: the Trent-Witham-Ancholme Scheme, public water supply demands, with charts of growth rates, direct demands by industrial and agricultural firms, and increasing demands of the 1970's. In addition, quality considerations were listed as the physical qualities of temperature, color, turbidity, and pH, the chemical qualities of alkalinity, total hardness, non-carbonate hardness, chlorides and dissolved solids, and pollution indicators such as ammoniacal nitrogen, dissolved oxygen, five day biochemical oxygen demand, and four hour permanganate value. The design criteria for this project fall into two categories--'Supply works' and 'Conservation Works'. Also discussed are particular sites such as Short Ferry, Fosdyke Canal, and Torksey Works. Specific problems including pipelines, chlorination, outfall works, and reservoir facilities are detailed. (Prague-FIRL)  
W74-08882

**RECENT DEVELOPMENTS ON WATER POLLUTION LEGISLATION.**  
Environmental Protection Agency, Boston, Mass. Permits Branch.  
For primary bibliographic entry see Field 5G.  
W74-08895

**WATER LAW AND THE HYDROLOGIC CYCLE: A TEXAS EXAMPLE.**  
Texas Tech Univ., Lubbock. Dept. of Geography. O. W. Templer.  
Water Resources Bulletin, Vol 9, No 2, p 273-283, April, 1973. 2 fig, 39 ref.

Descriptors: \*Water law, \*Legislation, \*Texas, Riparian rights, Groundwater, \*Hydrologic cycle, \*Water rights, Water utilization, Water wells, Water yield.

The law divides water in the cycle into several different classes. Each is treated separately and generally without consideration of interconnections existing within the cycle. Different rules of law have arisen concerning the ownership and use of each legal class. Under Texas law several classes of surface and ground water are recognized, and weather modification efforts bring yet another class, atmospheric moisture, under consideration. It is instructive to follow water moving through the hydrologic cycle in the Nueces River basin, Texas, as a framework for discussing the substantial interconnections between the various legal classes of water and the difficulties that arise from attempts to apply different rules of law to each class. Strictures imposed by Texas water law can seriously interfere with coordinated, efficient use and management of water resources, as evidenced by the Nueces River basin. Well-recognized, existing water rights in the several phases of the hydrologic cycle make change of these institutional constraints difficult to achieve. (Skogerboe-Colorado State)  
W74-08930

**STATE EX REL. LUDWIG V. CITY OF BEMIDJI (ACTION FOR INJUNCTION AND DAMAGES AGAINST CITY FOR POLLUTING RIVER).**  
212 N.W.2d 876 (Minn. 1973).

Descriptors: \*Minnesota, \*Judicial decisions, \*Water quality control, \*Legal aspects, \*Permits, Regulations, Standards, Water law, State governments, Administrative agencies, Environmental effects, Legislation, Ecology, Water resources, Appeals, Water policy, Natural resources, Pollution prevention, Pollution control, Pollution abatement, Municipalities.

A proceeding in the Supreme Court of Minnesota was brought by residents of a county to enjoin a city from polluting a river and to recover damages arising from the nuisance maintained by the city. The trial court dismissed the injunction suit and the plaintiffs appealed. The Supreme Court held that notice of hearing concerned with adoption of pollution standards was insufficient to confer jurisdiction upon the Pollution Control Agency to revoke a permit previously issued to the city. The Court further held that the city could not adequately prepare for a hearing which was designed to enforce a standard not yet adopted, and that failure to afford the city an individual hearing to resist the proposed order constituted a violation of the statute which operated to deprive the Pollution Control Agency of its jurisdiction over the city. Absent proper, prior notice that a hearing would be conducted to establish pollution standards, adopt regulations and revoke permits for sewage disposal in interstate waters, the city could not be amenable to the agency's jurisdiction. The judgement was affirmed. (Silber-Florida)  
W74-09121

**BLANEY V. RITTALL (ACTION ATTACKING PERMIT GRANTED TO CORPORATION WHICH ALLOWED THE BUILDING OF A WHARF).**  
312 A.2d 522 (Me. 1973).

Descriptors: \*Maine, \*Judicial decisions, \*Legal aspects, \*Permits, \*Legislation, Standards, Environmental effects, Administrative agencies, State governments, Environmental protection, Estuaries, Wetlands, Natural resources, Land management, Land development, Water policy, Administrative decisions, Legislation, Ecology, Water resources, Water resources development, Coasts.

A proceeding in the Supreme Judicial Court of Maine was brought by an adjoining landowner under the wharves and weirs statute and the Wetlands Control Act attacking a permit granted by the Board of Selectmen of Boothbay Harbor to a corporation purporting to allow it to construct a wharf on its property. The Supreme Judicial Court held that the corporation was a proper appellant and, that because the corporation had failed to file a description or sketch of the affected land with its permit, the permit issued under the Wetlands Control Act was invalid. The corporation filed two applications and after notice and hearing, the municipal officers, with approval from the Wetlands Control Board, issued one permit authorizing the applicant to alter coastal wetlands. This action by the governmental agency was subject to appeal. The trial court found that an incomplete recording of the permit occurred which did not satisfy the statutory requirement and ruled that the permit was therefore void. The Wetlands Act requires that a license be approved if one seeks to alter or drain or deposit sanitary sewage on a coastal wetland, swamp, marsh, bog, etc. This judgement was thus affirmed. (Silber-Florida)  
W74-09122

**IT'S ABOUT TOO LATE FOR TAHOE.**  
For primary bibliographic entry see Field 5G.  
W74-09124

**WATER POLLUTION-GOVERNMENTAL ACTIVITIES IN BROWARD COUNTY.**  
For primary bibliographic entry see Field 5G.  
W74-09125

**CONTROLLING POLLUTION.**  
Grove City Coll., Pa. Dept. of Economics.  
For primary bibliographic entry see Field 5D.  
W74-09128

**SUSQUEHANNA RIVER BASIN COMPACT.**  
Pa. Stat. Ann., secs. 820.1-820.8 (1968).

Descriptors: \*Pennsylvania, \*Interstate compacts, \*Legislation, \*Water law, \*Water resources development, Water planning, Water development, Water management, Water policy, Interstate rivers, Cooperation, Coordination, State governments, Water rights, Equitable apportionment, Rivers, River basins, River basin development, Watersheds, Watershed protection, Inland waterways, Navigable waters, Water distribution, Water demand, Water supply, Water utilization.

The state's participation in the Susquehanna River Basin Compact (Compact) is authorized. The participants recognize their joint responsibility in the conservation, utilization, development, management and control of the water resources of the basin under a comprehensive multiple purpose planning effort which will bring the greatest benefits and produce the most efficient service in the public interest. One section of the component recognizes the interrelated interests and rights of the many sovereignties through which the river flows and the importance of inter-governmental cooperation and the establishment of a single administrative agency to effectively and economically direct the future of the area's water resources. Another important provision to all users of water and of water related facilities without regard to political boundaries. The Compact grants generous administrative powers to the agency in order that its purposes and intentions may be carried out with the maximum efficiency and in the best public interest. (Silber-Florida)  
W74-09129

**DITCH V. HESS (ACTION TO RESTORE FREE FLOW OF SURFACE WATER).**  
212 N.W.2d 442 (Ia. 1973).

Descriptors: \*Natural flow doctrine, \*Adjudication procedure, \*Surface runoff, \*Judicial decisions, \*Obstruction to flow, Preferences (Water rights), \*Iowa, Surface drainage, Riparian rights, Conjunctive use, Culverts, Water sources, Legislation, Relative rights, Remedies.

Plaintiff brought action to restore free flow of surface water from her land and to recover for crop damage which allegedly resulted from interference with such flow. The court held that plaintiff, as owner of the upper, dominant estate had a legal and natural easement in the lower, servient estate for drainage of surface water and the servient owner could not interrupt or prevent the natural flow or passage of waters to the detriment of the dominant owner. The court further stated the dominant owner could cast additional surface water upon the servient estate, as long as no substantial damage is done. The defendants, to whom a strip of land was conveyed for construction of an access road were entitled to maintain the roadway in a useable condition, but when the road is raised above the adjoining land, facilities must be constructed to permit free passage of water. Since defendants removed the drainage pipe from their access road, thereby causing damage to adjoining landowner's crops from the surface water remaining, an award of damages was justified against defendants and the drainage pipe was ordered restored. (Sutton-Florida) W74-09130

**JENKINS V. PEDERSEN (ACTION BY ADJOINING PROPERTY OWNER AGAINST NEIGHBOR FOR DIVERTING SURFACE WATER ONTO PLAINTIFF'S PROPERTY).** 212 N.W.2d 415 (Ia. 1973).

Descriptors: \*Iowa, \*Judicial decisions, \*Legal aspects, \*Obstruction to flow, \*Groundwater barriers, Riparian rights, Streamflow, Natural flow doctrine, Water policy, Water management, Diversions, Structures, Dams dikes, Water law, Flow control, Water control, Drainage, Runoff, Water distribution, Flooding.

A proceeding in the Supreme Court of Iowa was brought by property owners against adjoining property owners who allegedly diverted surface waters so they drained onto plaintiffs' property. The trial court awarded damages and granted a mandatory injunction. The defendants appealed and the Supreme Court reversed, holding that the jury's finding that the dike constructed by the adjoining owners did not contribute to the plaintiffs' damages was error. Furthermore, the trial court's granting of the mandatory injunction requiring removal of the dike was an abuse of discretion. Where surface water has a fixed and certain course, its flow cannot be interrupted to injury of an adjoining proprietor and equity will enjoin the obstructing of such natural flow of water when necessary to prevent irreparable harm. But a showing of irreparable harm is necessary to invoke the injunctive jurisdiction of the court. (Silber-Florida) W74-09131

**RAY V. RANOWSKY (INJUNCTION AGAINST CONSTRUCTION OF DRAIN IN WATERSHED).** 210 N.W.2d 810 (Mich. Ct. App. 1973). 5 p.

Descriptors: \*Michigan, \*Watersheds (Basins), \*Constitutional law, \*Assessments, \*Drainage systems, Legislation, Right-of-way, Judicial decisions, Legal aspects, Construction costs, Water law, Watershed management.

Residents of a Michigan watershed sought to enjoin the county drain commissioner from proceeding with construction of a watershed drain and assessment of the residents for the cost of the project. The drain commissioner is charged by

Michigan law with determining the necessity for any such project, and plaintiffs argued that the cost of the project was an element in making that determination, which the commissioner had failed to consider. The Court of Appeals held that a required post-approval public meeting was the proper forum to review the benefits and cost of the project, and thus not an element of the determination of necessity. Plaintiffs argued that such a procedure would be a denial of due process, leaving them recourse only to challenge their individual assessments following approval of the plan. The Court concluded that special assessments are constitutional if founded upon special benefits which accrue to the landowners from the improvement. The Appellate Court then refused to overrule the finding of the trial court that the plaintiffs' land had benefited in its use and resale value, and that the benefits were directly attributable to the drainage project. (Ritchie-Florida) W74-09132

#### WEATHER MODIFICATION.

Pa. Stat. Ann., secs. 1101 thru 1118 (1968).

Descriptors: \*Pennsylvania, \*Artificial precipitation, \*Cloud seeding, \*Regulation, \*Conservation, Water resources development, Legal aspects, Water shortage, Administrative agencies, Administration, Legislation, State governments, Adoption of practices, Coordination, Public health, Safety, Research and development, Aircraft, Rain, Dry seasons, Legal aspects, Decision making, Planning, Political aspects, Water resources.

Identifiers: \*Administrative regulations, \*Licenses, Notice.

The public health and safety require scientific experimentation to increase natural precipitation in order to develop, conserve, and to protect the natural water resources of the state of Pennsylvania. The statute creates a Weather Modification Board to advise the Department of Agriculture on these matters. A license is required by the department before any endeavor takes place to cause condensation or precipitation. It is unlawful to possess any cloud seeding equipment unless the possessor has a license or he is under contract with a person who has such a license. The statute sets forth the information to be on the application, including the application fee and insurance coverage. Each license must be renewed annually. A person who owns cloud seeding equipment, but who does not want a license must nevertheless register with the board. A published notice of intention will include the name and address of the licensee, the nature and object of the intended operation, and the area and time where the operation will be conducted. These provisions do not have to be complied with if there is an emergency such as the need to extinguish fires. The county commission may also request such action to relieve a drought. A violation of this statute is a misdemeanor, and any pilot who wrongfully partakes in such a project may lose his license for five years. (Sperling-Florida) W74-09133

**WHEELING CREEK WATERSHED PROTECTION AND FLOOD PREVENTION DISTRICT COMPACT.**

Pa. Stat. Ann., secs. 819.1-819.3 (1967).

Descriptors: \*Pennsylvania, \*Interstate compact, \*Legislation, \*Flood control, \*Water resources development, Flood prevention, Water planning, Water development, Water management, Water policy, Interstate rivers, Cooperation, Coordination, State governments, Water rights, Watersheds, Water conservation, Wildlife conservation, Recreation, Reservoirs, Dams, Fishlife, Agricultural conservation, Administrative agencies.

The Wheeling Creek Watershed Protection and Flood Protection District Compact is created. The Compact in turn establishes a district to carry out the intent and purposes of the Compact. The district has the responsibility of planning and implementing improvements for flood control and flood prevention within its jurisdiction as well as applying for federal funds and other assistance in carrying out plans for works and improvements. It shall also be the purpose of the act that the district engage in public fish and wildlife conservation and recreational development, including the operation and construction of all necessary facilities. Furthermore, the Compact authorize the operation and maintenance of reservoirs and dams, and the allocation and control of all phases of agricultural conservation in cooperation with the United States Department of Agriculture. The district shall assure landowners and water users such water rights as they have acquired, as well as cooperating with soil conservation districts and all other state, local and federal agencies in promoting the most efficient methods of carrying out the purposes of the Compact. (Silber-Florida) W74-09134

**WATER DISCHARGE PERMIT PROGRAM BEGINS DESPITE LACK OF EFFLUENT STANDARDS.**

For primary bibliographic entry see Field 5G. W74-09138

**ARCTIC PASSAGE—LEGAL HEAVY WEATHER.** D. E. Milsten. Orbis, Vol 15, No 4, p 1173-1193, Winter 1972.

Descriptors: \*Arctic, \*Arctic Ocean, \*Natural resources, \*Water resources development, \*Legal aspects, Water law, Polar regions, Boundary disputes, Water rights, Boundaries, Navigable waters, Developed waters, International law, International commissions, International waters, Commercial fishing, Water quality, Water pollution control, Mineralogy, Land development.

With the successful navigation of the Arctic ice pack through the Northwest Passage by the specially equipped icebreaking oil tanker, S.S. Manhattan, the prospect of considerable public and private development has again risen. A vast wealth of minerals is known to exist in the Arctic. Competition in the development of these resources raises the potential for political challenge between the nations interested in Arctic development and the use of the common resource—the ocean. Of major concern is the use of certain waterways as access routes for rapidly expanding developmental situations. Also, the ocean areas themselves are subject to development efforts, as seen in the growing importance of continental shelf resources and fishing. The question of pollution in the seas is a growing concern for many nations. In 1970 Canada enacted two measures which extended its territorial waters to twelve miles and asserted control over Arctic waters up to 100 miles from the mainland for the purpose of preventing oil pollution, while establishing standards of performance for vessels transiting Arctic waters. Disputes over sovereignty and international law will have to be resolved before Arctic development can be realized. (Silber-Florida) W74-09139

**A BILL TO CREATE A MARINE RESOURCES CONSERVATION AND DEVELOPMENT FUND: TO PROVIDE FOR THE DISTRIBUTION OF REVENUES FROM OUTER CONTINENTAL SHELF LANDS; AND FOR OTHER PURPOSES.** Senate Bill 2672, 93d Cong. 1st Sess (1973). 8 p.

Descriptors: \*Federal government, \*Legislation, \*Coasts, \*Natural resources, \*Continental shelf, \*Conservation, Marine fisheries, Oceans, Water pollution, Water pollution control, Government

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

finance, Aquaculture, Erosion, Shores, Shore protection, Recreation, Flood protection, Oceanography, Regional development, Research and development, Mineralogy, Exploration. Identifiers: \*Marine Resources Conservation and Development Act, \*Outer Continental Shelf Lands Act.

This bill would amend the Outer Continental Shelf Lands Act. All rentals, royalties or other sums paid in connection with any lease on the Outer Continental Shelf which is attributable to that portion of the Outer Continental Shelf adjacent to any state or that portion to which a state by interstate compact has limited itself shall be deposited as follows: 70% in a special fund to be known as the Marine Resources Conservation and Development Fund (MRCDF); and 30% to the adjacent states to be used for conservation purposes, including the prevention and abatement of environmental pollution in the coastal areas of the state. The MRCDF shall be available for marine resources conservation and development programs for fresh and salt water pollution control, fresh and salt water aquaculture, prevention of beach and shoreline erosion, hurricane and flood prevention, aid to sea grant colleges, fishery development, recreational facilities and oceanographic research and development. The MRCDF shall also be used to establish Regional Environmental Review Boards to inspect the exploration, production and transportation of minerals off the coast of their respective regions. (Ritchie-Florida) W74-09140

**INDUSTRIES WIN FEW CONCESSIONS AS POLLUTION PERMIT PLAN MOVES ON SCHEDULE.**  
J. R. Wagner.  
National Journal, Vol 3, p 932-938, May 1, 1971.

Descriptors: \*Water law, \*Permits, \*Water quality control, \*Water pollution control, \*Industrial waste disposal, Regulations, Wastewater disposal, Legal aspects, Water pollution sources, Water policy, Environmental sanitation, Navigable waters, Federal government, Standards, Administrative agencies, Impaired water quality, Sewage disposal, Water permits, Water utilization, Planning, Water resources development, Water management, Governments, Water treatment, Pollution abatement.

The Environmental Protection Agency and the Army Corps of Engineers are enforcing the July 1, 1971 date as the deadline for all industries discharging waste into navigable waters to apply for federal permits to continue their discharges, even though the affected industries do not have all the regulations necessary to fully comply. Without more legislation (Refuse Act) agency officials claim full authority to launch the permit program and to enforce it. If polluting industries fail to comply with the program's requirements, they can expect court action. The new regulations appear to have been written so as to withstand possible legal challenges to the permit program. Fish and wildlife protection are given special emphasis and attention. Vessels will not be required to apply for permits. Municipal systems of liquid waste discharge are not included within the 1899 Refuse Act, but industries are liable for criminal sanctions if they attempt to discharge their wastes through municipal sewage systems. Effluent guidelines appear to be the most important of the regulations as they define the degree of pollution allowed to industries in the major categories. (Silber-Florida) W74-09141

**WATERCRAFT: MARINE TOILETS.**  
Mo. Stat. Ann., tit. 19, sec. 306.260 (1972).

Descriptors: \*Missouri, \*Legislation, \*Sewage, \*Sewage disposal, Sewage treatment, Septic tanks, Sewage lagoons, Water pollution, Water pollution sources, Water quality, Mississippi River, Missouri River, Boats, Equipment.

Identifiers: \*Interstate commerce, Marine toilets.

All marine toilets on any boat, operated upon the waters of Missouri, shall be so constructed and operated as to contain all sewage aboard the boat, and not to discharge any sewage into the waters directly or indirectly. All sewage when removed from any boat shall immediately be placed in an approved septic tank, sanitary lagoon or sewage treatment system. This statute does not apply to boats engaged in interstate commerce on the Missouri and Mississippi rivers. (Ritchie-Florida) W74-09143

**LITTLE CALUMET RIVER FLOOD CONTROL COORDINATING COMMISSION.**  
Ill. Pub. Acts 1973, ch. 78-782, sec. 1, to be codified as Ill. Stat., ch. 19, sec. 112.11 to 112.17.

Descriptors: \*Legislation, \*Rivers, \*Flood control, Flood protection, Streamflow.  
Identifiers: \*Flood Control Act.

The Little Calumet River Flood Control Coordinating Commission is created. The commission shall examine and study all existing and future plans and policies in relation to flood control in and along the Little Calumet River and its tributaries. The commission shall coordinate the various programs of federal and state agencies involving flood control in and along the river and its tributaries, excluding control of funds for dredging, diking, channelization or other such flood control measures. The commission shall report findings, conclusions and recommendations, including drafts of suggested legislation to the General Assembly no later than March 1 of each year. The commission may employ and fix the compensation of such staff as it considers necessary and desirable. (Silber-Florida) W74-09144

**LANGFORD V. KRAFT, DOWNING AND WOOTEN ENTERPRISES V. KRAFT (DAMAGE FROM FLOOD RUNOFF).**  
498 S.W.2d, 42-52 (Texas 1973).

Descriptors: \*Flooding, \*Surface runoff, \*Storm runoff, Water control, Drainage system, Natural flow, Diversion, Texas.

An action was taken by an adjoining landowner against real estate developers and their engineer for damages and for an injunction with respect to the flooding of the owner's land by discharge from the storm sewer system. The district court issued a temporary injunction and the engineer appealed from the ruling. The court of appeals held the trial court did not abuse its discretion in granting the temporary injunction, that the action against the engineer was properly maintainable in the county in which the alleged trespass occurred and that the statute pertaining to venue of ordinary injunction suits was not applicable. The court held that the developer's actions causing water runoff to adjoining land caused damage in violation of a statute prohibiting diversion or impounding of natural flow of surface waters in a manner that damages the property of another. Once the violation is shown, the doctrine of balancing of equities is inapplicable in determination whether to grant an injunction. (Daniels-Florida) W74-09145

**OVER 40 YEARS OF REGIONAL SERVICES.**  
Hartford Metropolitan District, Water Bureau, Conn.  
G. Gufstafson, and H. Phillips.  
Journal of American Water Works, Vol 65, No 4, p 243-247, April 1973, 4 p, 4 fig, 3 photo, 1 ref.

Descriptors: \*Connecticut, \*Water districts, \*Water distribution (Applied), \*Water supply, \*Filtration, Reservoirs, Recreation facilities.

The water district which serves Hartford County, Connecticut is described. The district is a municipal corporation formed in 1930. The district supplies water to about 400,000 people within the twenty mile radius provided for in its charter and also collects and treats sewage for the area. It has four pollution control plants which utilize the activated-sludge process. There are six active water-supply reservoirs within the district and also a compensating reservoir with a capacity of three billion gallons. The compensating reservoir has never been used as a water supply reservoir. It was originally built to compensate well owners during periods of low flow, but now it also serves as a recreational area for swimmers, boaters, and fishermen. Although the district's raw water is low in turbidity and color, the district decided long ago to adopt filtration to ensure the safest and clearest water possible. The slow sand process is used in the older facilities but the new plants have gone to the rapid sand process due to its ease of automation, reduced space requirements, and lower construction costs. (McKnight-Florida) W74-09146

**EFFECTS OF PENDING FEDERAL DRINKING-WATER LEGISLATION.**  
C. Atkinson, Jr.  
Journal of American Water Works Association, Vol 65, No 9, p 579-581, September 1973, 1 photo.

Descriptors: \*Potable water, \*Legislation, \*Standards, Utilities, Industries, Water quality control, Water quality standards.

Changes in drinking-water standards and what these changes are going to mean to the water utility industry are discussed. A public affairs committee was established with the prime purpose to see that officers and members of the American Water Works Association are informed on matters affecting water and related subjects. All bills now before Congress provide for greater supervision and control of drinking water than in the past. The bills provide that the federal government is to conduct and promote research, technical assistance and training of water-supply personnel. The conclusion reached by the committee is that the proposed safe-drinking-water legislation will, if passed, have far-reaching effects on state and local programs and on the water industry. (Daniels-Florida) W74-09147

**WATER IMPROVEMENT COMMISSION.**  
Me. Rev. Stat. Ann., Vol 16, tit 38, secs 361-367 (Supp. 1973).

Descriptors: \*Maine, \*Legislation, \*Water pollution control, \*Environmental control, Sewage, Wastes, Industrial wastes, Tidal waters, Water quality standards, Inter-agency cooperation.

Maine's Board of Environmental Protection was established to represent manufacturing interests, the public generally and conservation interests. It will exercise the police power of the State to control, abate and prevent the pollution of the air, waters, coastal flats and provide for the best use of the natural resources of the State of Maine. The Board shall consult and advise municipal authorities on sewage and industrial wastes; make such regulations as are reasonably necessary; conduct hearings and establish a continuous planning process in cooperation with state, federal and regional agencies consistent with the Federal Water Pollution Control Act. It shall establish standards for fresh, tidal and marine water protection. (Daniels-Florida) W74-09148

**PROTECTION AND IMPROVEMENT OF WATERS.**  
Me. Rev. Stat. Ann., Ch. 16, Tit. 38, Sec. 451-454 (Supp. 1973).

## WATER RESOURCES PLANNING—Field 6

### Water Law and Institutions—Group 6E

Descriptors: \*Maine, \*Water quality control, \*Legislation, Navigable waters, Surface water, Law enforcement, Water quality standards.  
Identifiers: Enforcement.

This is the enforcement provision of the waters and navigation laws of the state of Maine. The Statute provides that after adoption of any classification by the legislature for surface waters, it is unlawful for any person or firm to dispose of sewage or any industrial waste in such manner as will alter diffusion and mixture with the receiving waters lower the quality of said waters below the minimum requirements. The purpose of these mixing zones is to allow a reasonable opportunity for dilution, diffusion or mixture of wastes with the receiving waters before the receiving waters below or surrounding a discharge will be tested for classification violations. Where no mixing zones have been established it shall be unlawful for any person or firm to dispose wastes into any classified waters that will lower the quality of waters below the minimum standards, notwithstanding any licenses which may have been granted or issued. Provisions for revocation, modification or suspension of licenses for mixing zones are included within this enforcement section. (Daniels-Florida) W74-09149

#### NATURAL AND SCENIC RIVERS SYSTEM.

N.C. Gen. Stat., secs. 113A-30 through 113A-43 (1971).

Descriptors: \*North Carolina, \*Scenic easements, \*Aesthetics, \*River systems, Wild rivers, Administrative agencies, Boundaries(Property), River flow, Social aspects, Economic aspects, Land management.

North Carolina has adopted a policy aimed at the retention of natural and scenic conditions in the state's rivers. This is to be accomplished by maintaining them in a free-flowing state and protecting their water quality. For inclusion into the natural and scenic river system the river or river segment must meet the following criteria: the length must be greater than one mile; the boundaries on the shoreline must not be less than twenty feet nor more than 320 acres (except by donation) of land per mile; water quality must be essentially unpolluted at present; the water flow shall be sufficient to assure a continuous flow, and not be subject to withdrawal or regulation that would substantially alter the natural ecology of the stream; and, public access must be limited in keeping with the purpose of this statute. The administration of the statute is the responsibility of the Department of Conservation and Development. The Department also has authority to plan, develop, and acquire land. It can either acquire complete ownership of the land or scenic easements thereon. Anyone who donates land or an easement is entitled to a charitable deduction under North Carolina law. (Sperling-Florida) W74-09150

#### WHAT CONSTITUTES PUBLIC WATERWAYS AND RIGHTS.

Miss. Code Ann., sec. 51-1-4 (Supp. 1973).

Descriptors: \*Mississippi, \*Water rights, \*Water policy, Navigable waters, Riparian rights, Public rights, Recreation, Channels, Water zoning, Water allocation(Policy).  
Identifiers: Navigability tests.

Criteria are established as to what constitutes public waterways and the subsequent rights thereon. Such portions of all natural flowing streams having a length of not less than five miles and an average depth along the thread of the channel of three feet for ninety consecutive days in the year and an average width at low water of not less than thirty feet, shall be public waterways of the state of Mississippi on which citizens of this state or any other state shall have the right of free trans-

port and the right to fish and engage in water sports. Except as otherwise provided by law nothing herein contained shall authorize any person, firm or corporation utilizing said public waterways to disturb the banks or beds of such waterways or discharge any object or substance into such waters or upon or across the lands adjacent thereto. This section shall not be construed to prohibit the construction of dams or reservoirs in the manner authorized by law, or to amend or repeal any law relating to pollution or water conservation. This section does not apply to man-made waterways. (Silber-Florida) W74-09151

#### DREDGING OF OYSTER SHELLS FROM PUBLIC LAND UNDER CHESAPEAKE BAY AND POTOMAC RIVER.

Ann. Cd. of Md., art. 66C, sec. 13B (1970).

Descriptors: \*Maryland, \*Legislation, \*Administrative agency, \*Dredging, Navigable waters, Public lands, Decision making, Tidal waters.  
Identifiers: Coastal zone management.

A permit is required to remove sand, gravel, or any other resources from the public lands under navigable waters of the Chesapeake Bay and the Potomac River. In the application for the permit, the location of the land where the resources are to be taken should be noted. Required survey stakes should be driven, where possible, at definite corners of the tract. The application for the permit must be accompanied by a ten dollar fee. Persons who dredge oyster shells from the public lands under the navigable waters of the aforementioned bodies of water must leave approximately one hundred feet of bottom untouched for every one thousand feet dredged. These untouched strips will be maintained and it will be unlawful for any person to destroy or damage them by dredging or other means. (Sperling-Florida) W74-09152

#### CONSERVATION AND LAND DEVELOPMENT.

Pa. Stat. Ann., secs. 5001-5013, p 48-51 (1967).

Descriptors: \*Pennsylvania, \*Legislation, \*Water management, \*Conservation(Natural resources), \*Land management, Land development, Erosion control, Streams, Beaches, Shores, Recreation, Wildlife, Forests, Land use, Watershed protection, Flood plains, Marshes, Groundwater, Administrative agencies.

Pennsylvania's Open Space Lands policy is established. It is the legislative intent and purpose to clarify and broaden the existing methods in which land may be preserved or acquired for open space uses. The state finds that it is an essential policy to meet the needs for recreation, amenity and conservation of natural resources, including farm lands, forests and a pure and adequate water supply. The Department of Forests and Waters is authorized to acquire interests in or purchase real property to protect and conserve water resources and watersheds, forests and timberlands, and to protect existing or planned park, forest, wildlife preserve or other recreation and conservation sites by controlling the use of contiguous or nearby lands in order to protect the scenic, aesthetic or watershed values of the sites. The Department is also charged with the responsibility of protecting and conserving the soils, beaches, streams, flood plains and marshes of the state and protecting and enhancing their scenic, historic, geologic, and botanic importance. (Silber-Florida) W74-09153

#### 2 OBJECTIVES 4 ACCOUNTS.

Water Resources Council, Washington, D.C.

W. D. Fairchild.

Water Spectrum, Vol 5, No 4, p 22-27, 1973. 4 photo, 1 chart.

Descriptors: \*Planning, \*Water resources development, \*Water policy, \*Water supply, Inter-agency cooperation, Multi-purpose projects, Political aspects, Social function.  
Identifiers: Water Resources Council.

The revised Principles and Standards for water planning, issued by the U.S. Water Resources Council are discussed. The main objective was to place environmental concerns on an equal basis with economic development. By considering national economic development, environmental quality, regional development and social well being, an opportunity to fully evaluate projected effects and tradeoffs of alternate plans is provided for. The Principles and Standards reflect that the country's values are changing. Under the new principles, the public's role will be stimulated, as plan formulation will require public participation to be sought early and continually throughout the process. Implementation of the Principles and Standards will push progress towards defining positive ways of identifying effects in a descriptive way. No comment is given on cost considerations as changes in such provisions will be through legislative actions. (Sutton-Florida) W74-09154

#### DIVERSION OF WATER.

S.C. Code Ann., sec. 59-16 (1970).

Descriptors: \*South Carolina, \*Water law, Rivers, Bays, Diversion, Routing, Diversion structures, Consumptive use, Structures, Canals, Conduits, Ditches, Electric powerplants.

The South Carolina Public Service Authority is authorized to divert water from the Sampit River, Penny Royal Creek and their tributaries for use in connection with the operation of an electric generating plant to be constructed between the Sampit River, Penny Royal Creek and Winyah Bay and to discharge such water, or so much thereof as is not consumed into Winyah Bay. Such diversion shall not exceed two thousand cubic feet of water per second each day, and may be accomplished by canals, conduits, ditches, pipes or other proper structures. This provision shall not be construed to waive the laws as to pollution control, and shall not affect the right of any person to recover damages sustained as a result of the diversion of water permitted by this section. (Ritchie-Florida) W74-09155

#### PUBLIC WATER SUPPLY, SEWERAGE AND SOLID WASTE DISPOSAL SYSTEM.

Md. Code Ann., art. 43, sec. 387C (Supp. 1973).

Descriptors: \*Maryland, \*Administrative agencies, \*Adoption of practices, \*Coordination, Water conveyance, Waste water disposal, Solid waste.

A county plan for the public water supply, sewerage, and solid waste disposal systems will delineate those areas where community water supply systems must be provided and where individual water supply systems may be installed and used in the interim although in some areas individual water supply systems may be installed and used for an indefinite period. Each plan will also show where community sewerage systems must be provided as well as where individual systems can be used. Adequate sewage treatment facilities are required to prevent the discharge of inadequately or untreated sewage or other liquid waste into any waters. In addition every county plan will establish procedures for acquiring necessary rights-of-way or easements for the community water supply, or sewerage and waste acceptance and disposal systems. A time schedule and proposed methods of financing the construction and operation, as well as the estimated cost of each system are to be included in the plan. Each county plan must indicate the source of the water

## Field 6—WATER RESOURCES PLANNING

### Group 6E—Water Law and Institutions

supply, the amount withdrawn from waters of the state of Maryland, and the quantity and quality of wastes to be discharged into the waters of the state. (Sperling-Florida)  
W74-09156

**COUNTY SEDIMENT CONTROL PROGRAMS.**  
S.C. Code Ann., secs. 63-195.101 through 63-195.106 (1971).

Descriptors: \*South Carolina, \*Legislation, Erosion, Siltation, Sedimentation, Sediment control, Soil conservation, Soil erosion.

Any county in South Carolina may establish a sediment control program upon adoption of a resolution by the body authorized to levy taxes within the county, and shall then designate the proper agency to administer and enforce the program. In counties establishing such a program, no minerals shall be commercially mined nor shall ground be broken for construction until a grading permit is obtained. Plans which will outline methods to control erosion and siltation must be submitted and approved prior to obtaining a permit. Construction of single-family residential dwellings and agricultural buildings is exempted from the above provision. Fines may be imposed for violation of the above provisions and the soil and water conservation districts and the governing body of each county are empowered to obtain injunctive relief for violations of any grading plan previously submitted. (Ritchie-Florida)  
W74-09157

**POLLUTION CONTROL FACILITIES.**  
S.C. Code Ann., secs. 63-195.51 through 63-195.65 (1971).

Descriptors: \*Air pollution, \*South Carolina, \*Pollution abatement, Financing, Taxes, Waste disposal, Industrial wastes, Cities.

South Carolina has enacted statutes governing the financing and letting of contracts for construction of pollution control facilities, which are any facilities designed for the elimination, mitigation or prevention of air or water pollution. The facilities include all things which are required to collect, treat and thereafter dispose of all waste of any sort originating in or about any industrial enterprise. Prior to undertaking the financing of any pollution control facility, a finding is required by the Pollution Control Authority of South Carolina that the pollution control facilities are necessary and that the design will result in the elimination, mitigation and prevention of air or water pollution. Counties and municipalities are empowered to enter into agreements with any industry to construct and thereafter operate, maintain and improve pollution control facilities, to enter into loan agreements with such industry and to issue tax exempt bonds to defray the cost of constructing or enlarging any pollution control facilities. (Ritchie-Florida)  
W74-09158

**WATER CONSERVATION.**  
La. Rev. Stat. secs. 38:2552 thru 38:2907 (Supp. 1973).

Descriptors: \*Louisiana, \*Sewage disposal, \*Water districts, Soil conservation, Land use, Recreation facilities.

The Bayou D'Arbonne Lake Watershed District shall be a political subdivision of the state of Louisiana and shall have as its purpose the conservation of soil and water, and the development of the natural resources and wealth of the district for sanitary, agricultural and recreational purposes. The Bossier Parish police jury is authorized to regulate and control the types of private sewage disposal systems or other private facilities that may discharge pollutants into the waters within the Cypress-Black Bayou Watershed. Other statutes

are suspended insofar as they limit the size of park and recreational facilities authorized for erection and construction by the Board of Commissioners of the Black Bayou Watershed District. The Board is urged to take steps necessary to take advantage of federal financial assistance that is or may become available. The Jackson Parish Watershed District shall have for its purpose the conservation of soil and water and the development of the natural resources and wealth of the district. The district shall have all the powers, rights, privileges and immunities of a public corporation. (Napolitano-Florida)  
W74-09159

**RED RIVER WATERWAY.**  
La. Const. Art. 14 sec 30.5 (Supp. 1973).

Descriptors: \*Louisiana, \*Navigable rivers, \*Governmental interrelations, Easements, Right-of-way, Land use, Capital costs, Tax rates, Bonds, Leases, Water districts.  
Identifiers: Red River, Atchafalaya River.

The Louisiana Constitution creates the Red River Waterway extending from the vicinity of the confluence of Red River with Old River and the Atchafalaya River northwestward in the Red River Valley to the state boundary. This navigable waterway system is created for the purpose of establishing, operating, and maintaining cooperation with the federal government. The state legislature is empowered to create the Red River Waterways District which shall be the body politic. The legislature shall prescribe the jurisdiction, objects, purposes, power and authority of the district. In addition to other powers which the legislature may confer upon it, the district governing body shall be authorized: to levy an annual tax not to exceed 1.5 miles on all taxable property within the district for purposes of capital outlay including cost of acquisition of rights-of-way and compensation; to fund bonds for the accomplishment of capital outlay; to expropriate property; to acquire by purchase, donation, lease or otherwise, and to hold and use any property real, personal or mixed, tangible or intangible, or any interest therein necessary or desirable for carrying out the objects and purposes of the district; and to create and establish port sub-districts within the confines of the district. (Napolitano-Florida)  
W74-09160

**HAYES V. STATE (FENCING ON NAVIGABLE WATERS).**  
496 S.W. 2d 372-375 (Ark. 1973). 4 p.

Descriptors: \*High water mark, \*Riparian rights, \*Navigable rivers, River beds, Judicial decisions, Arkansas, Riparian land, Ownership of beds, Boundaries(Property).

The case involved the defendants', riparian land owners, right to erect a fence. The defendants' right was dependent on two determinations, one being whether the river was navigable at that point and the other being the location of the ordinary high water mark. The Supreme Court of Arkansas affirmed the finding that the river was navigable but reversed the order concerning the ordinary high water mark. The Court said that high water mark was to be determined by examining the bed and banks to ascertain where the presence of the water was so usual and continued as to mark upon the beds a character distinct from the bank in respect to vegetation and the nature of the soil itself. This reversal allowed the defendants to maintain their fence. (Sears-Florida)  
W74-09161

**NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION.**  
R.I. Gen. Laws Ann., secs. 46-16-1 through 46-16-1.3 (Supp. 1972).

Descriptors: \*Legislation, \*Rhode Island, \*Interstate compacts, \*Interagency cooperation, Water pollution abatement, Cooperation.

The state of Rhode Island is authorized to reaffirm its support and participation in the cooperative approach to the abatement and control of water pollution as embodied in the New England interstate water pollution control compact. The New England interstate water pollution control commission shall develop programs in view of increasing population concentrations, the growing needs of industry and agriculture for water of reasonable quality, and the quality requirements of water-based recreation and other uses. The commission shall also develop and maintain programs and research on water quality problems. The commission may employ those personnel necessary to carry out its functions, including engineering, technical and professional specialists. (Silber-Florida)  
W74-09163

**WHO OWNS THE WATER.**  
J. McCall.  
Environment, Vol 12, p 31-39, October 1970. 4 photo.

Descriptors: \*Water pollution control, \*Water quality control, \*International commissions, \*U.S. legislation(National and State), International joint commission, Water quality standards, Federal Water Pollution Control Act, Sewage disposal, Environmental sanitation, Sewage bacteria, Administrative agencies.

An analysis of water pollution in the world's rivers is divided into a consideration of international measures for water quality control, U.S. measures, and measures employed by other countries. Efforts to improve water quality in the rivers of Europe indicate a failure to place the realization of water pollution above political considerations. The United Nations and the World Health Organization in conjunction with the efforts of the nations themselves have done little more than declare water policy. This seems unsatisfactory in that policy remains useless without means of implementation and methods of enforcement. In general then, international activity seems insufficient to control pollution. On the national level in the United States, development of state agencies and water commissions are evidence of an effort to grant authority to establish water management programs with broad controls. Notwithstanding the effects of political necessity, chances for improvement appear greater in this approach than in international cooperation. Other nations of the world have developed patterns of attack similar to that of the United States. Problems throughout the world remain in the area of sewage treatment. Treatment processes must be refined in order to decrease water pollutants. (Proctor-Florida)  
W74-09164

**COUNTY SANITATION FACILITIES INSPECTION.**  
Tenn. Code Ann., secs. 5-1913 through 5-1916 (1969).

Descriptors: \*Environmental sanitation, \*Waste water disposal, \*Environmental engineering, Tennessee, Sewage treatment, Local governments, Public health, Sewage disposal.

Procedures are defined for inspections of county sanitation and disposal facilities. The county sanitarian and commissioner of public health are permitted to inspect these facilities at their own initiative, however they must do so at least quarterly. The county sanitarian and the commissioner can give technical advice and assistance to local officials for the betterment of their refuse disposal practices. It is also realized that existing rights are not to be lessened by the addition of these statutes. However, a restriction is placed on an individuals

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### Ecologic Impact Of Water Development—Group 6G

right to dispose of solid wastes on his own property, but only if such disposal will create a public nuisance or hazard to the public health. (Sutton-Florida)  
W74-09165

#### **INTERSTATE ENVIRONMENTAL COMPACT.**

Tenn. Code Ann., sec. 53-5001 (1972).

Descriptors: \*Legislation, \*Tennessee, \*Inter-agency cooperation, \*Interstate compacts, Comprehensive planning, Interstate commissions, Governmental interrelations.

The state of Tennessee is authorized to enter with all other jurisdictions legally joining the interstate environmental compact. The compact was established to promote intergovernmental cooperation with environmental pollution problems that transcend state boundaries. The compact was also designed to avoid duplicate efforts by many individual agencies dealing with similar problems among the separate states. The state is authorized to execute supplementary agreements provided that the governor and legislature approve of the action to be taken. Nothing within this act shall be construed as invalidating any provision of law of any signatory, nor shall it modify or qualify the authority of any signatory to enact or enforce environmental protection legislation within its jurisdiction and not inconsistent with any provision of the compact. (Silber-Florida)  
W74-09166

#### **AUTHORITY TO LEASE SEA BOTTOM.**

Miss. Code Ann., sec. 49-15-27 (1972).

Descriptors: \*Mississippi, \*Leases, \*Legislation, \*Water resources development, Sea water, Oceans, Administrative agencies, Riparian rights, Ports, Harbors, Channels, Recreation, Beaches, Shores, Marine life.

The Mississippi state commission created herein is authorized to lease sea bottoms within its jurisdiction providing the area is not now or hereafter designated as a tonging reef or natural reef or the area is not within the boundaries of riparian property owners. All individual lessees shall be residents of the state corporations organized under the laws of the state. No person may lease less than five acres nor more than one hundred acres, and any firm which holds or controls or attempts to hold or control by any device, more than two hundred acres of water bottom shall forfeit the leases so held by it. All leases shall be subject to the paramount right of the state and its subdivisions to promote and develop ports, harbors, channels, industrial or recreational projects. Such leases shall be awarded under such conditions as will insure the maximum culture and propagation of oysters. (Silber-Florida)  
W74-09168

#### **SOIL AND WATER CONSERVATION.**

Pa. Stat. Ann., secs. 849-862, p 85-92 (1972).

Descriptors: \*Pennsylvania, \*Legislation, \*Erosion control, Agriculture, Dams, Reservoirs, Navigable waters, Harbors, Flood control, Drainage, Land use, Wildlife, Watersheds, Soil erosion.

The Soil and Water Conservation policy of the state of Pennsylvania is established as to all matters, concerns, and aspects of agriculture. The purposes of the law are to provide for the conservation of the soil, water and related resources of the state; control and prevent soil erosion, thereby preserving natural resources; assist in flood control; prevent impairment to dams and reservoirs; maintain the navigability of rivers and harbors; preserve wildlife; and protect public lands. The act creates the State Conservation Commission whose responsibility it is to offer assistance to conserva-

tion districts, to approve and coordinate joint programs among the several districts, to aid in land and water management and conservation of related natural resources and to approve projects and recommend priorities for planning for watershed management and development. The commission shall also have financial and contract powers as well as the authority to establish conservation districts when the public interest necessitates such action. (Silber-Florida)  
W74-09169

#### **MARINE RESOURCES COUNCIL.**

Miss. Code Ann., secs. 57-15-5 through 57-15-7 (1972).

Descriptors: \*Mississippi, \*Legislation, \*Administrative agencies, \*Marine biology, \*Water resources development, Coasts, Sea water, Aquatic life, Marine geology, Beds, Coastal plains, Shores, Beaches.  
Identifiers: Marine Resources Council(Miss).

The Marine Resources Council is created to study, plan, report, make proposals and recommendations for the development and utilization of the coastal and offshore lands, waters and marine resources of the state, and to insure that all future plans and programs involving said marine resources will be coordinated with comparable agencies of the United States. The Council shall have as its aim to provide for effective, efficient and economic development of marine resources available to the state, and to cause suitable skilled professionals and labor to harness the marine resources of the state's coastal, offshore and water resources toward achieving the highest economic growth potential possible in the oceanographic field and scientific discovery of underwater marine resources. The Council shall cause to be carried out the continuing study of the science of oceanography and the development of a long-range oceanographic program for the State of Mississippi. (Silber-Florida)  
W74-09170

#### **PROPOSED LONG DRAW RESERVOIR ENLARGEMENT PROJECT, COLORADO, AN APPLICATION UNDER THE SMALL RECLAMATION PROJECTS ACT (FINAL ENVIRONMENTAL IMPACT STATEMENT).**

Bureau of Reclamation, Denver, Colo.  
For primary bibliographic entry see Field 8A.  
W74-09172

#### **A QUIET REVOLUTION: FLORIDA'S FUTURE ON TRIAL.**

Florida State Senate, Tallahassee.  
For primary bibliographic entry see Field 4B.  
W74-09173

### **6F. Nonstructural Alternatives**

#### **SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, TAOS COUNTY,**

New Mexico State Univ., University Park. Dept. of Agronomy.  
For primary bibliographic entry see Field 3F.  
W74-09054

#### **SUITABILITY OF NEW MEXICO LANDS FOR IRRIGATION.**

New Mexico State Univ., University Park. Dept. of Agronomy.  
For primary bibliographic entry see Field 3F.  
W74-09055

#### **SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, MCKINLEY COUNTY.**

New Mexico State Univ., University Park. Dept. of Agronomy.

For primary bibliographic entry see Field 3F.  
W74-09056

#### **SOIL ASSOCIATIONS AND LAND CLASSIFICATION FOR IRRIGATION, VALENCIA COUNTY.**

New Mexico State Univ., University Park. Dept. of Agronomy.  
For primary bibliographic entry see Field 3F.  
W74-09057

#### **A QUIET REVOLUTION: FLORIDA'S FUTURE ON TRIAL.**

Florida State Senate, Tallahassee.  
For primary bibliographic entry see Field 4B.  
W74-09173

### **6G. Ecologic Impact Of Water Development**

#### **MAN-MADE LAKES: THEIR PROBLEMS AND ENVIRONMENTAL EFFECTS.**

For primary bibliographic entry see Field 4A.  
W74-08747

#### **LAKE NASSER.**

Lake Nasser Development Centre, Aswan, (Egypt).  
For primary bibliographic entry see Field 4A.  
W74-08749

#### **ENVIRONMENT: A BIBLIOGRAPHY OF SOCIAL SCIENCE AND RELATED LITERATURE.**

Michigan State Univ., Lansing.  
For primary bibliographic entry see Field 10D.  
W74-08824

#### **ENVIRONMENTAL MANAGEMENT AND LOCAL GOVERNMENT.**

International City Management Association, Washington, D.C.  
For primary bibliographic entry see Field 6E.  
W74-08827

#### **ENVIRONMENTAL IMPACT ANALYSIS: A REVIEW OF THREE METHODOLOGIES.**

Wisconsin Univ., Madison. Inst. for Environmental Studies.  
M. L. Warner, and D. W. Bromley.  
Available from the National Technical Information Service as PB-232 947 \$3.75 in paper copy, \$1.45 in microfiche. Wisconsin Water Resources Center, Madison, Technical Report. 1974. 69 p. 5 figs. 6 tables, 125 refs. OWRR B-057-WIS (3). 14-31-0001-3354.

Descriptors: Resources, Economics, \*Environmental effects, \*Decision making, \*Testing procedures, \*Water quality control, \*Water Quality standards, \*Idaho, Methodology, Evaluation, Reviews.  
Identifiers: \*Environmental impact.

The National Environmental Policy Act of 1969 (NEPA) required the filing of environmental impact statements by Federal agencies proposing major actions significantly affecting the quality of the human environment. This research suggests bases for the evaluation and further development of methodologies used to prepare impact statements. Three methodologies are critically analyzed. They are: the 'Lepold approach,' suggested by Luna B. Leopold, et. al. (1971), the 'Battelle approach,' developed at Battelle's Columbus Laboratories for the U.S. Bureau of Reclamation (Dee, et. al. 1972), and the 'WRC approach,' contained in the 'Principles and Standards for Planning Water and Related Land Resources' of the U.S. Water Resources Council (1973). Specific criteria for methodology evalua-

## Field 6—WATER RESOURCES PLANNING

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tion are developed within the areas of: technical ecological content, practical applicability, and political utility. These criteria are designed to emphasize a 'full-disclosure law' interpretation of NEPA. The methodologies are examined using each set of criteria in turn. To provide a more concrete setting for this analysis, a test case involving a proposed U.S. Bureau of Reclamation water resources development project in Southwest Idaho was used. Data collection consisted of a point-by-point comparison of criteria and related desirable characteristics to each methodology. These data are analyzed for overall methodological conformance to the criteria to yield conclusions on the strengths and weakness of the methodologies.

W74-08839

**ENVIRONMENTAL TECHNOLOGY AT NORWICH UNIVERSITY.**  
Norwich Univ., Northfield, Vt. Dept. of Engineering and Technology.  
G. R. Pyper.

Journal of the New England Water Works Association, Vol 88, No 1, p 32-43, March, 1974. 3 ref.

Descriptors: \*Education, \*Environmental engineering, Universities, Training, Colleges, \*Vermont.  
Identifiers: Course of study, \*Norwich University (Vermont).

The new and innovative 4 yr curriculum in Environmental Engineering Technology at Norwich University, Northfield Vermont, is described. The objective of the program is to produce an environmental technologist who has the technical competence to work with environmental engineers and support environmental activities with minimum supervision. The course of study includes the following environmental courses: Environmental Pollution, Air Resource Engineering, Hydrology and Water Resources, Water Analysis Instruments, Air Sampling and Monitoring, Water Pollution Control, Air Analysis Instruments, Air Field Lab Problems, and Water Field Lab Problems. The predominant characteristic of the technologist who will graduate from this program will be the technical ability to identify and define the extent of environmental pollution or establish that no pollution exists. (Merritt-FIRL)

W74-08871

**A FOSSIL PLANT ENVIRONMENTAL IMPACT STUDY.**  
Nebraska Public Power District, Columbus.  
For primary bibliographic entry see Field 5C.  
W74-08874

**SIGNIFICANCE OF ECOLOGICAL ANALYSES IN THE INTERPRETATION OF ENVIRONMENTAL RELEASES OF RADIONUCLIDES.**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 5C.  
W74-08878

**FINAL ENVIRONMENTAL STATEMENT RELATED TO THE PROPOSED HOPE CREEK GENERATING STATION UNITS 1 AND 2.**  
Directorate of Licensing (AEC), Washington, D.C.  
For primary bibliographic entry see Field 5C.  
W74-08959

**FINAL ENVIRONMENTAL STATEMENT RELATED TO OPERATION OF NINE MILE POINT NUCLEAR STATION UNIT 1.**  
Directorate of Licensing (AEC), Washington, D.C.  
For primary bibliographic entry see Field 2H.  
W74-08960

**FINAL ENVIRONMENTAL STATEMENT RELATED TO CONSTRUCTION OF ST. LUCIE PLANT, UNIT 2.**

Directorate of Licensing (AEC), Washington, D.C.  
For primary bibliographic entry see Field 5C.  
W74-08961

**NUCLEAR ENERGY AND THE ENVIRONMENT, AN INTERVIEW WITH A.G.C. COMMISSIONER DIXIE LEE RAY.**

For primary bibliographic entry see Field 5G.  
W74-09135

**ONE DAMMED THING AFTER ANOTHER.**

For primary bibliographic entry see Field 5G.  
W74-09136

**THE UPPER HUDSON WHITEWATER OR WASHWATER.**

For primary bibliographic entry see Field 6D.  
W74-09137

**PROPOSED LONG DRAW RESERVOIR ENLARGEMENT PROJECT, COLORADO, AN APPLICATION UNDER THE SMALL RECLAMATION PROJECTS ACT (FINAL ENVIRONMENTAL IMPACT STATEMENT).**

Bureau of Reclamation, Denver, Colo.  
For primary bibliographic entry see Field 8A.  
W74-09172

## 7. RESOURCES DATA

### 7A. Network Design

**DESIGN OF COST-EFFECTIVE WATER QUALITY SURVEILLANCE SYSTEMS.**  
Raytheon Co., Portsmouth, R.I. Oceanographic and Environmental Services.  
For primary bibliographic entry see Field 5A.  
W74-08825

**DIMENSIONS OF MONITORING.**

MITRE Corp., McLean, Va.  
R. P. Ouellette, and J. W. Overbey, II.  
In: Cycling and Control of Metals; Proceedings of Environmental Resources Conference, October 31-November 2, 1972, Columbus, Ohio: Environmental Protection Agency National Environmental Research Center, p 159-165, February 1973. 9 fig, 12 ref.

Descriptors: \*Monitoring, \*Water pollution, \*Air pollution, Networks, Network design, Systems analysis.

Monitoring networks yield vast amounts of raw data which must be transformed into usable information by a filtering process which generally involves a complex transfer function. Monitoring systems exist in support of the decision making process for recommending actions. This process feeds on information not data. A systems approach can be used in designing these networks. (See also W74-09206) (Knapp-USGS)

W74-09217

### 7B. Data Acquisition

**AN INVESTIGATION OF THE COULTER COUNTER IN 'BIOMASS' DETERMINATIONS OF NATURAL FRESHWATER PHYTOPLANKTON POPULATIONS.**

Royal Holloway Coll., Egham, Surrey (England).  
For primary bibliographic entry see Field 5A.  
W74-08727

**A JEEP-MOUNTED RAINFALL SIMULATING INFILTROMETER.**

Northern Arizona Univ., Flagstaff.  
W. R. Henkle.

In: Hydrology and Water Resources in Arizona and the Southwest, Proc. of the 1973 meetings of the Arizona Section-AWRA and the Hydrology Section-Arizona Academy of Science, May 4-5, 1973, Tucson, Arizona, p 107-111, (1973). 2 fig, 4 ref.

Descriptors: \*Infiltrometer, \*Raindrops, \*Rainfall intensity, \*Rainfall simulators, \*On-site tests, Infiltration, Runoff, Rainfall, Flow rates, Flow measurement, \*Arizona, Mechanical equipment.

An infiltrometer was designed to more closely simulate natural storm characteristics and still maintain sufficient portability to be used in various test sites in the field. In addition to portability, a relatively large test plot can be used over a relatively long duration. The instrument is designed to produce rainfall intensities of 2 to 6 inches per hour which are comparable to natural storm intensities found in northern Arizona. Capillary tubes produce water drops of equivalent kinetic energy at impact to natural raindrops. Errors due to lateral flow are minimized through peripheral wetting. Mounting the infiltrometer on a four-wheel drive vehicle allows nearly the portability of a hand carried unit with a greater water carrying capacity and allows the equipment to be large enough to test a representative plot. (Mastic-Arizona)

W74-08766

**INSTRUMENTATION AND ENVIRONMENTAL RADIATION ASSESSMENT SYSTEMS.**

Office of Radiation Programs, Washington, D.C.  
For primary bibliographic entry see Field 5B.  
W74-08876

**AN AIRBORNE GAMMA RAY SPECTROMETER AND ITS APPLICATION IN NUCLEAR POWER PLANT SITE SURVEYS.**

Rice Univ., Houston, Tex.  
For primary bibliographic entry see Field 5A.  
W74-08908

**LIGHTING UP THE HAZE OF TURBIDITY MEASUREMENT.**

Process Engineering, p 68-71, March, 1974. 4 fig, 1 tab.

Descriptors: \*Turbidity, \*Measurement, \*Light, Light intensity, Optical properties, Instruments.  
Identifiers: Turbidimeters, Nephelometers, Scattered light, Transmitted light.

The measurement of turbidity and turbidity measuring instruments which utilize optical methods and operate on several different principles are described. Some instruments operating on the reflected beam or scattering principles measure the scattering at 90 degrees and others measure low angle scattering up to 45 degrees. In some cases the ratio between the amount of transmitted light and of scattered light is measured. Measurement of the intensity of light transmitted through a liquid is known as turbidimetry and instruments operating on this principle are turbidimeters. Measurement of the intensity of scattered light is known as nephelometry and instruments using this principle are nephelometers, but instruments measuring the ratio of the transmitted and scattered light are also often known as turbidimeters. Diagrams of four different turbidimeters are presented and their operation is explained. (Merritt-FIRL)

W74-08912

**TURBIDIMETERS MONITOR DUBAI FLOOD WATER.**

The Oil and Gas Journal, Vol 72, No 15, p 68, April 15, 1974. 1 fig.

## RESOURCES DATA—Field 7

### Evaluation, Processing and Publication—Group 7C

Descriptors: \*Turbidity, \*Measurement, Water quality, Treatment facilities, Waste water treatment, Equipment.  
Identifiers: \*Light scattering, \*Turbidimeters, \*Dubai, Arabian Gulf.

Turbidimeters utilizing a forward light scattering technique are monitoring water purity for water-flooding oil fields in the Arabian Gulf. The instruments use two modular subsystems, a transmitter and a converter. The transmitter is mounted in the process line and projects a beam of light through the process stream. The turbidimeters are insensitive to color and bubbles so produce accurate measurements of solids loading. Linear solid state detectors convert the varying intensity of the light scattered from the particulates into electrical signals. These signals are processed by the converter to produce an instantaneous computation and display of turbidity. (Merritt-FIRL)  
W74-08913

**FLUID SAMPLE ANALYSIS SYSTEM,**  
Durrum Development Corp., Palo Alto, Calif. (assignee)  
E. L. Durrum, C. O. Forge, P. L. Y. Lee, and K. L. Mackinnon.  
U.S. Patent 3,806,321. Official Gazette of the U.S. Patent Office, Vol 921, No 4, p 1577, April 23, 1974. 1 fig.

Descriptors: \*Patents, \*Liquids, \*Analytical techniques, \*Ion exchange, Separation techniques, Mixing, Pressure, Tubes.  
Identifiers: Reagent, Eluent.

A fluid sample analysis system is described which is characterized by an ion exchange column which operates on a time basis. A reagent supply line under substantial positive pressure discharges reagent into the eluent of the ion exchange column for mixing reagent and eluent. There is a back pressure resistance to passage of fluid which is substantially matched to the back pressure resistance provided by the ion exchange column. The system is further characterized by means for mixing the eluent and reagent and by a tubular reaction coil. (Merritt-FIRL)  
W74-08914

**THE EFFECT OF EXCLUSION VOLUME ON POTENTIOMETRIC NITRATE MEASUREMENT,**  
Arkansas Univ., Fayetteville. Dept. of Agronomy.  
For primary bibliographic entry see Field 2G.  
W74-08919

**TERRESTRIAL HEAT FLOW IN THE TERRITORY OF CZECHOSLOVAKIA AND THE MEASUREMENT OF THERMAL CONDUCTIVITY WITH FULLY-AUTOMATIC APPARATUS,**  
Ceskoslovenska Akademie Ved, Prague. Geofyzikalni Ustav.  
For primary bibliographic entry see Field 4B.  
W74-09004

**ENDOCRAVE, A NEW DEVICE FOR THE STUDY OF HEAT AND MASS TRANSFER BY SIMULATION OF GEOLOGICAL BODIES AND PROCESSES UNDER DYNAMIC CONDITIONS,**  
Akademiya Nauk SSSR, Novosibirsk. Institut Geologii i Geofiziki.  
For primary bibliographic entry see Field 2F.  
W74-09007

**HEAT TRANSFER MEASUREMENT IN THE OWAKUDANI AND SOUNZAN GEOTHERMAL AREAS, HAKONE VOLCANO,**  
National Research Center for Disaster Prevention, Tokyo (Japan).  
For primary bibliographic entry see Field 2F.  
W74-09008

**NEUTRON WELL LOGGING IN HAWAII,**  
Hawaii Univ., Honolulu. Water Resources Research Center.  
For primary bibliographic entry see Field 4B.  
W74-09053

**A PORTABLE DEVICE FOR MEASURING WASTEWATER FLOW IN SEWERS,**  
Hittman Associates, Inc., Columbia, Md.  
For primary bibliographic entry see Field 5D.  
W74-09061

**BORE HOLE SAMPLING OF SATURATED UNCEMENTED SANDS AND GRAVELS,**  
Commonwealth Scientific and Industrial Research Organization, Syndal (Australia). Div. of Applied Geomechanics.  
For primary bibliographic entry see Field 4B.  
W74-09094

**THE POSSIBILITIES OF THE IDENTIFICATION OF PRECIPITATION ZONES WITH MISZ (METEOROLOGICAL ARTIFICIAL EARTH SATELLITES),**  
For primary bibliographic entry see Field 2B.  
W74-09196

**SEISMIC REFRACTION ANALYSIS OF WATERSHED MANTLE RELATED TO SOIL, GEOLOGY, AND HYDROLOGY,**  
Forest Service (USDA), Rapid City, S. Dak. Rocky Mountain Forest and Range Experiment Station.  
For primary bibliographic entry see Field 2G.  
W74-09199

**CYCLING AND CONTROL OF METALS.**  
For primary bibliographic entry see Field 5B.  
W74-09206

**MONITORING FOR TRACE METALS--WATER ENVIRONMENT,**  
National Environmental Research Center, Cincinnati, Ohio.  
For primary bibliographic entry see Field 5A.  
W74-09215

**MONITORING OF SOLID WASTES,**  
Michigan Univ., Ann Arbor.  
For primary bibliographic entry see Field 5A.  
W74-09216

**THE USE OF ION SPECIFIC ELECTRODES FOR CHEMICAL MONITORING OF MARINE SYSTEMS: PART I--THE AMMONIA ELECTRODE AS A SENSITIVE WATER QUALITY INDICATOR PROBE FOR RECIRCULATING MARICULTURE SYSTEMS,**  
Delaware Univ., Newark. Coll. of Marine Studies.  
For primary bibliographic entry see Field 5A.  
W74-09220

**EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES,**  
National Environmental Satellite Service, Hillcrest Heights, Md.  
For primary bibliographic entry see Field 2C.  
W74-09230

**SURVEY OF LAKE FLOODING FROM ERTS-1: LAKE CHAMPLAIN.**  
Vermont Univ., Burlington. Dept. of Geography.  
For primary bibliographic entry see Field 2H.  
W74-09231

**AERIAL RADIOLOGICAL MEASURING SURVEY OF THE AREA SURROUNDING THE**

**DRESDEN NUCLEAR POWER STATION, MORRIS, ILLINOIS, SEPTEMBER 1968,**  
EG and G, Inc., Las Vegas, Nev.  
For primary bibliographic entry see Field 5A.  
W74-09250

### 7C. Evaluation, Processing and Publication

**ESTIMATION AND MAPPING OF RATES OF EXCHANGE OF FRESH GROUNDWATER IN THE BALTIC ARTESIAN BASIN (OTSENKA I KARTIROVANIYE TEMPOV VODOOBMEENA PRESNYKH PODZEMNYKH VOD (NA PRIMERE PRIBALTIYSKOGO ARTEZIAN-SKOGO BASSEYNA)),**  
Akademiya Nauk SSSR, Moscow. Institut Vodnykh Problem.  
For primary bibliographic entry see Field 2F.  
W74-08705

**LAKE POWELL RESEARCH PROJECT: HYDROLOGIC RESEARCH,**  
California Univ., Los Angeles. Inst. of Geophysics.  
For primary bibliographic entry see Field 2H.  
W74-08767

**THE EFFECT OF DATA DENSITY ON GROUNDWATER CONTOURING ACCURACY,**  
Arizona Univ., Tucson. Dept. of Soils, Water and Engineering.  
For primary bibliographic entry see Field 2F.  
W74-08781

**DESIGN OF COST-EFFECTIVE WATER QUALITY SURVEILLANCE SYSTEMS,**  
Raytheon Co., Portsmouth, R.I. Oceanographic and Environmental Services.  
For primary bibliographic entry see Field 5A.  
W74-08825

**PREDICTION OF DEW POINT TEMPERATURE, SOLAR RADIATION AND WIND MOVEMENT DATA FOR SIMULATION AND OPERATIONS RESEARCH MODELS,**  
Hydrocomp, Inc., Palo Alto, Calif.  
For primary bibliographic entry see Field 2B.  
W74-08933

**PHOTOGRAMMETRIC TECHNIQUES APPLIED IN THE DEVELOPMENT OF GEOTHERMAL RESOURCES IN MATSUKAWA AND OTAKE GEOTHERMAL AREAS USING A VECTOR METHOD,**  
International Geodetic Survey Inst. Co. Ltd., Tokyo (Japan).  
For primary bibliographic entry see Field 4B.  
W74-09012

**STATIC INTERPRETATION OF CHEMICAL RESULTS FROM DRILLHOLES AS AN AID TO GEOTHERMAL PROSPECTING AND EXPLOITATION,**  
Department of Scientific and Industrial Research, Wellington (New Zealand).  
For primary bibliographic entry see Field 4B.  
W74-09014

**DIGITAL-COMPUTER PROGRAMS FOR ANALYSIS OF GROUND-WATER FLOW,**  
Geological Survey, Little Rock, Ark.  
For primary bibliographic entry see Field 2F.  
W74-09115

**WATER RESOURCES DATA FOR GEORGIA, 1973.**  
Geological Survey, Doraville, Ga.  
Data Report, 1974. 231 p, 4 fig, 4 tab, 7 ref.

## Field 7—RESOURCES DATA

### Group 7C—Evaluation, Processing and Publication

Descriptors: \*Hydrologic data, \*Surface waters, \*Georgia, Water quality, Streamflow, Gaging stations, \*Data collections, Discharge(Water), Sampling, Solutes, Water temperature.

Water resources data for the 1973 water year for Georgia include records of streamflow or reservoir storage at gaging stations, partial-record stations, miscellaneous sites, and records of water-quality data on the chemical and physical characteristics of surface water as well as records for a few pertinent gaging and water-quality stations in bordering States. The base data collected at gaging stations consist of records of stage and measurements of discharge of streams or canals, and stage, surface area, and contents of lakes or reservoirs. (Knapp-USGS)  
W74-09116

**APPLICATION OF THE GREEN AND COREY METHOD FOR COMPUTING HYDRAULIC CONDUCTIVITY IN HYDROLOGIC MODELING.**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 2G.  
W74-09195

**SURFACE WATER TEMPERATURES AT SHORE STATIONS, UNITED STATES WEST COAST, 1972.**  
Scripps Institution of Oceanography, La Jolla, Calif.  
For primary bibliographic entry see Field 2E.  
W74-09197

**SMALL-STREAM FLOOD INVESTIGATIONS IN ALASKA, A COMPILATION OF PEAK DATA, MAY 1963 TO SEPTEMBER 1972.**  
Geological Survey, Anchorage, Alaska.  
For primary bibliographic entry see Field 2E.  
W74-09218

**EFFECT OF MINE DRAINAGE ON THE QUALITY OF STREAMS IN COLORADO, 1971-72.**  
Geological Survey, Lakewood, Colo.  
For primary bibliographic entry see Field 5B.  
W74-09228

**ANNUAL REPORT ON GROUND WATER IN ARIZONA, SPRING 1972 TO SPRING 1973.**  
Geological Survey, Phoenix, Ariz.  
For primary bibliographic entry see Field 4B.  
W74-09229

**EVALUATION OF ERTS DATA FOR CERTAIN HYDROLOGICAL USES.**  
National Environmental Satellite Service, Hillcrest Heights, Md.  
For primary bibliographic entry see Field 2C.  
W74-09230

## 8. ENGINEERING WORKS

### 8A. Structures

**TECHNICAL DEVELOPMENTS.**  
For primary bibliographic entry see Field 8G.  
W74-08820

**DEVICE FOR CONDUCTING WASTE LIQUID FROM A RECEPTACLE TO A PNEUMATIC LIQUID DISPOSAL SYSTEM.**  
Aktiebolaget Electrolux, Stockholm (Sweden). (assignee)  
S. E. A. Svanteson.  
U.S. Patent 3,807,431. Official Gazette of the U.S. Patent Office, Vol 921, No 5, p 1874, April 30, 1974. 1 fig.

Descriptors: \*Patents, \*Equipment, \*Liquid waste, Sewage, \*Waste disposal, \*Air.  
Identifiers: \*Liquid waste transport.

An apparatus for conveying waste liquid from a hold receptacle to a vacuum sewage disposal system is described. The waste liquid is conducted through a transport conduit into which atmospheric air is able to enter. The air-waste liquid provides a more efficient moving of the waste. (Merritt-FIRL)  
W74-08901

**REVIEW OF PRECAST PRESTRESSED CONCRETE WATER STORAGE RESERVOIRS.**  
Natgun Corp., Wakefield, Mass.  
For primary bibliographic entry see Field 8F.  
W74-08906

**GEOHERMAL DRILLING AND PRELIMINARY TEST OPERATIONS AT KIZILDERE, TURKEY.**  
Mineral Research and Exploration Inst., Ankara (Turkey). Technical data.  
E. Durucan, and K. Olcenoglu.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1463-1466, 1973. 4 fig.

Descriptors: \*Drilling, \*Well casings, \*Geothermal studies, Wells, Water temperature, Steam, Hydrothermal studies, Rotary drilling, Drilling equipment, Well screens.  
Identifiers: \*Geothermal power, \*Turkey(Kizildere).

The drilling equipment utilized for steam boreholes in Turkey is described with reference to drilling mud used and cementing operations. The first geothermal well drilling for natural steam at Kizildere was started in 1968. From the first test well a mixture of steam and hot water was produced. Up to now, seven deep test wells have been completed. Six of them are in the first reservoir and the seventh one is in the second reservoir. Gradient wells are about 100 m in depth. These have been drilled to measure the value of geothermal gradients in the different places of the field. The deep test wells go down to the reservoir. They have been drilled for testing and also for production purposes. (See also W74-08973) (Knapp-USGS)  
W74-09029

**PRESENT STATE OF DRILLING AND REPAIRING OF GEOHERMAL PRODUCTION WELLS IN JAPAN.**  
Teiseki Sakusei Kogyo Co. Ltd. (Japan).  
K. Matsuo.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1467-1479, 1973. 9 fig, 1 tab.

Descriptors: \*Drilling, \*Well casings, \*Geothermal studies, Wells, Water temperature, Steam, Hydrothermal studies, Rotary drilling, Drilling equipment, Well screens.  
Identifiers: \*Geothermal power, \*Japan.

Japan is a prominently volcanic country with many hot springs and abundant geothermal resources. As a result of exploration during the past ten years, many geothermal wells were drilled, and geothermal electric power stations have been constructed in two areas of Matsukawa in the Iwate Prefecture and at Otake in Kyushu. The drilling of geothermal production wells is basically the same as that of petroleum and natural gas. The rigs and equipment used for the drilling operation are exactly the same as those used for petroleum and natural gas. However, in the actual drilling opera-

tion, there are some problems which are inherent in the drilling of geothermal wells. (See also W74-08973) (Knapp-USGS)  
W74-09030

**GEOHERMAL DRILLING IN THE MATSUKAWA AREA.**  
Japan Metals and Chemicals Co. Ltd., Morioka.  
Y. Nakajima.  
In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1480-1484, 1973. 4 tab.

Descriptors: \*Drilling, \*Well casings, \*Geothermal studies, Wells, Water temperature, Stream, Hydrothermal studies, Rotary drilling, Drilling equipment, Well screens.  
Identifiers: \*Geothermal power, \*Japan(Matsukawa).

In the Matsukawa geothermal area of Japan 6 wild-cat holes and 6 production holes of 325-1500 meter depth have been drilled. Most of the hot water and the steam of that area exist in the fractured zone lying near the boundary between the Yamatsuda formation and the Tamagawa welded tuff at about 1,000 meters. Therefore, further drilling is being carried out aiming at that zone. The wells are comparatively deep, rocks are hard, temperature is high, and mud escape occurs frequently. Different drilling rigs were used according to the depth of 500, 1,000 and 1,500 meters. Chromite mud comparatively stable at high temperature was used for the circulated fluid. Pure water was used in case of mud escape. (See also W74-08973) (Knapp-USGS)  
W74-09031

**CASING STRING DESIGN FOR GEOHERMAL WELLS.**  
Ministry of Works, Wellington (New Zealand).  
N. D. Dench.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1485-1496, 1973. 7 fig, 7 tab, 10 ref.

Descriptors: \*Drilling, \*Well casings, \*Geothermal studies, Wells, Water temperature, Steam, Hydrothermal studies, Rotary drilling, Drilling equipment, Well screens.  
Identifiers: \*Geothermal power, New Zealand.

Drilling to depths exceeding 1600 feet was carried out in ten geothermal fields in the North Island of New Zealand. Measurements in the wells established the pattern of temperatures and pressures which occur throughout their depth and life, and which are used in calculating the various loads imposed on the casings. Changes of temperature caused by drilling operations result in severe casing stresses, and sometimes in failure, particularly in axial compression. The ability of several types of casing joints to resist this loading was measured in laboratory tests, and enough results have been obtained to allow the designer to estimate actual failure strengths for some joints, and to make the best choice for any particular service. By relating design loads to casing strengths for various conditions of stressing, a set of design factors has proved useful in assessing the adequacy of casing strings proposed for geothermal service. Downhole conditions and joint testing together with examples of casing designs are given. (See also W74-08973) (Knapp-USGS)  
W74-09032

**EFFECT OF SLOTTED LINEAR CASING IN GEOHERMAL BORES.**  
Japan Metals and Chemicals Co. Ltd., Morioka.  
Geothermal Power Div.  
K. Katagiri.

In: Proceedings of the United Nations Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy, Sept 22-Oct 1, 1970: Geothermics 1970, Special Issue 2, Vol 2, Part 2, p 1497-1501, 1973. 3 fig, 1 tab.

Descriptors: \*Drilling, \*Well casings, \*Geothermal studies, Wells, Water temperature, Steam, Hydrothermal studies, Rotary drilling, Drilling equipment, Well screens. Identifiers: \*Geothermal power, Japan.

Since 1964, six steam wells for geothermal power have been drilled in the geothermal area in Matsukawa, Japan. In drilling these steam wells, slotted liners with 6 5/8 inch diameter or 7 inch diameter have been unconditionally adopted. In drilling the sixth well, however, further study of the geological sequence of the hydrothermal reservoir suggested that the geological sequence in Matsukawa geothermal area was strong enough for an open hole. Only two months after completion, blocking occurred inside the hydrothermal reservoir. The blocked part was repaired immediately, but the failure showed the necessity of the slotted liner casing. Discharge is now about 60 tons per hour. (See also W74-08973) (Knapp-USGS) W74-09033

**FACTORS CONTROLLING BOREHOLE PERFORMANCE.** Department of Scientific and Industrial Research, Taupo (New Zealand). For primary bibliographic entry see Field 2F. W74-09034

**PROPOSED JETTY-HEAD REPAIR SECTIONS, HUMBOLDT BAY, CALIFORNIA.** Army Engineer Waterways Experiment Station, Vicksburg, Miss. D. D. Davidson. Available from NTIS, Springfield, Va. 22151, AD-756 212, Price \$3.00 printed copy; \$1.45 microfiche. Technical Report H-71-8, November 1971. 144 p, 31 plate, 60 photo, 12 ref.

Descriptors: \*Coastal engineering, \*Jetties, \*California, Shore protection, Bays, Harbors. Identifiers: \*Humboldt Bay(Calif).

Tests were conducted on a 1:50-scale model of the north jetty at Humboldt Bay, Calif., to determine how economical and stable repair sections can be designed to stop deterioration caused by wave action. Design of a satisfactory repair section is made difficult because of the large waves and day-to-day sea conditions that prohibit the use of floating plant for construction, the limited lifting capacity and horizontal reach of available land-based construction equipment, and the necessity of placing the armor unit toe protection on the existing underwater rubble mound. The study included the investigation of (a) the waves that can attack the proposed structure, (b) the effects of stability of linking the armor units, and (c) the optimum shape of armor unit and repair section that would be stable for the selected design-wave conditions. (Knapp-USGS) W74-09117

**PROPOSED LONG DRAW RESERVOIR ENLARGEMENT PROJECT, COLORADO, AN APPLICATION UNDER THE SMALL RECLAMATION PROJECTS ACT (FINAL ENVIRONMENTAL IMPACT STATEMENT).** Bureau of Reclamation, Denver, Colo. Available from National Technical Information Service, U.S. Dept. of Commerce, Springfield, Va., as EIS-CO-73-0183-F. February 7, 1973. 147 p, 4 tab, 15 map, 2 chart.

Descriptors: Effects, \*Reservoirs, \*Legislation, \*Dams, Damages, Backwater, Water storage, Irrigation, Flood control. Identifiers: \*Environmental Impact Statements, \*Long Draw Reservoir(Colo).

This project entails enlargement of the Long Draw Dam and Reservoir on La Poudre Pass Creek, located near Fort Collins, Colorado. The project includes construction of reservoir recreation facilities, lining short sections of the existing Grand River Ditch to reduce water seepage, and rehabilitation of associated existing ditch structures within Rocky Mountain National Park. The project will provide supplemental water to Front Range irrigators and reservoir related recreation opportunities. The water will irrigate 37,425 acres of cropland, increase crop yields, and stabilize farmer income and the local economy. Other benefits of the project include strengthening the existing dam, accommodating 33,000 visitor days of annual recreation, a permanent pool for maintaining a trout fishery, and reducing downhill erosion adjacent to the Grand River Ditch. About one hundred and six acres of wildlife habitat and one-half mile of a stream fishery will be inundated. Alternative considerations included not construction the project, winterizing the Grand River Ditch, modifying existing water systems and alternative dam and reservoir sites. (Conko-Florida) W74-09172

**MODEL STUDY OF TROTTERS SHOALS SPILLWAY.** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Lab. For primary bibliographic entry see Field 8B. W74-09204

**HULAH DAM EMERGENCY BULKHEAD PROTOTYPE CLOSURE TESTS.** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Lab. For primary bibliographic entry see Field 8C. W74-09205

## 8B. Hydraulics

**NUMERICAL COMPUTATION OF MOMENTUM JETS AND FORCED PLUMES.** Battelle-Pacific Northwest Labs., Richland, Wash. D. S. Trent, and J. R. Welty. Computer and Fluids, Vol 1, No 4, p 331-357, December, 1973. 24 fig, 1 tab, 17 ref.

Descriptors: \*Mathematical studies, Equations, \*Model studies, Turbulent flow, \*Jets. Identifiers: \*Plumes.

A numerical study of vertical momentum jets and forced plumes issuing to similar receiving media is presented. The complete partial differential equations governing steady, incompressible, turbulent flow are solved in axisymmetric coordinates using finite difference techniques. Solutions were based on the stream function vorticity transport approach for a Boussinesq fluid. Buoyant driving forces were coupled to the vorticity equation which included effects of temperature and other constituents. Turbulent transport coefficients were computed iteratively using the Prandtl eddy diffusivity model. Results for the momentum jet, axial, and radial distributions of velocity and concentration show excellent agreement with published data. Forced plume computations are presented which include similar results for densimetric Froude numbers ranging from 1 to 1000. (Merritt-FIRL) W74-08782

**SIMULATION OF DISSOLVED OXYGEN PROFILE.** Worcester Polytechnic Inst., Mass. Dept. of Mathematics. For primary bibliographic entry see Field 5B. W74-08823

**A PORTABLE DEVICE FOR MEASURING WASTEWATER FLOW IN SEWERS.** Hittman Associates, Inc., Columbia, Md. For primary bibliographic entry see Field 5D. W74-09061

**AN INVESTIGATION OF SECONDARY FLOW EFFECTS IN CURVED CHANNELS OF SQUARE CROSS SECTION.** Naval Postgraduate School, Monterey, Calif. P. S. Kenney. Available from NTIS, Springfield, Va. 22151 as AD-764 502 Price \$5.50 printed copy; \$1.45 microfiche. M Sc Thesis, June 1973. 63 p, 30 fig, 1 tab, 3 ref.

Descriptors: \*Open channel flow, \*Vortices, Meanders, Turbulent flow, Hydraulic models, Channel morphology. Identifiers: \*Secondary flow.

Turbulent flow in a curved channel of square cross section was investigated experimentally to determine secondary flow effects. Probe surveys were conducted to establish vortex and total pressure loss distribution in the exit plane of a 90 deg bend. Overall losses were determined by measuring the momentum of the flow with a force plate for different Reynolds numbers at turning angles of 0, 45, 90, and 135 deg. There is a definite increase in the average total loss coefficient with turning angle. (Knapp-USGS) W74-09193

**MODEL STUDY OF TROTTERS SHOALS SPILLWAY.** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Lab. B. P. Fletcher, and J. L. Grace, Jr. Available from NTIS, Springfield, Va. 22151 as AD-762 539 price \$3.00 printed copy; \$1.45 microfiche. Technical Report H-73-7, June 1973. 19 p, 9 fig, 24 plate, 12 photo, 1 tab.

Descriptors: \*Hydraulic models, \*Spillways, \*Open channel flow, Hydraulic jump, Spillway crests, Model studies, Energy dissipation, \*Georgia, \*South Carolina. Identifiers: \*Trotters Shoals Dam(Ga-SC).

The spillway for the Trotters Shoals Dam (Georgia and South Carolina) was tested on a 1:80-scale model to investigate flow conditions in the approach and exit channel and the performance of various elements of the structure. Particular emphasis was placed on the development of an energy dissipator that would provide satisfactory energy dissipation and exit channel flow conditions. Approach flow conditions were improved by revising the left abutment to prevent a severe drawdown of the water surface. After the left abutment was modified, the spillway capacity was equal to that computed. Nappe separation from the downstream quadrant of the crest was prevented by extending the crest piers upstream and shifting the gate slots downstream relative to their original positions. These modifications improved pressure conditions within the gate slots as well as along the spillway crest. The type 3 stilling basin provided more appropriate energy dissipation than flip buckets and it reduced the maximum velocities and the concentration of flow along the left side of the exit channel. The instantaneous forces induced by the hydraulic jump on the monoliths composing the left stilling basin wall were also determined. (Knapp-USGS) W74-09204

**SOME NEW METHODS OF TOPOLOGIC CLASSIFICATION OF CHANNEL NETWORKS.** IBM Thomas J. Watson Research Center, Yorktown Heights, N.Y. C. Werner, and J. S. Smart. Available from NTIS, Springfield, Va. 22151 as AD-759 385 - Price \$3.00 printed copy; \$1.45

## Field 8—ENGINEERING WORKS

### Group 8B—Hydraulics

microfiche. Technical Report No 9, January 24, 1973. 46 p, 11 fig, 4 tab, 25 ref. ONR Contract N00014-70-C-0188.

Descriptors: \*Geomorphology, \*Drainage patterns(Geologic), Drainage density, Streams, Channel morphology.

Identifiers: \*Topology.

Some new methods for the topologic classification of channel networks are proposed. These methods are all based on the concept of topologic path length, or number of links from the network outlet to a junction or source. Two parameters, the total path length (sum of all path lengths) and the diameter (largest path length), are useful in network analysis. Some advantages of these parameters are that they are easy to measure, have straightforward topologic interpretations, and are closely related to important geometric measures. Moreover, they are capable of explaining various empirical geomorphic laws, such as the 0.6 power relation between mainstream length and area. (Knapp-USGS)

W74-09221

### 8C. Hydraulic Machinery

#### AMERICAN RIVER PLANT ADDS AUTOMATED PUMPING STATION.

Instrumentation, Vol 27, No 1, p 6-9, 1974. 6 fig.

Descriptors: \*Reservoirs, \*Pumping plants, \*Automatic control, Remote control, Water supply development, \*California.

Identifiers: \*Sacramento(Calif), \*Florin Reservoir(Calif).

The Florin Reservoir and Pumping Station of the American River Water Treatment Plant is described. It is a remote-control, unmanned facility built completely underground in Sacramento, Calif. The Florin station is equipped with instrumentation which automatically starts, stops, or throttles the appropriate combination of three horizontal centrifugal split case pumps. Completion of the Florin Station represents a significant step in Sacramento's master plan of water system development and expansion to the year 2030 when the plant will handle 330 mgd. (Merritt-FIRL)

W74-08780

#### TUNNEL FAILURE DELAYS SEWER SYSTEM STARTUP.

Engineering News-Record, Vol 192, No 2, p12, January 10, 1974.

Descriptors: \*Pumping plants, \*Sewage, Tunnels, \*Sewers, Concrete pipes, \*Failures.

Operation of a 170 mgd sewage pumping station in lower Manhattan, under construction since 1967, will be delayed until 1975 because of the failure of two sections of interceptor sewer tunnel that have been completed since 1961, waiting to feed the station. The failure of the 300 ft of 9 ft diameter concrete lined interceptor appears related to the construction of the pumping station. The tunnel sections that failed were driven in soft ground under compressed air about 40 ft below the street. Their primary lining is cast iron segmental rings with steel rib support. (Merritt-FIRL)

W74-08790

#### DEVELOPMENT OF AUTOMATED SURFACE IRRIGATION.

Department of Agriculture, Lethbridge (Alberta). Research Station.

For primary bibliographic entry see Field 3F. W74-08804

#### DEVELOPMENT AND FUTURE OF DREDGING.

Corps of Engineers, Atlanta, Ga. South Atlantic Div.

For primary bibliographic entry see Field 5G. W74-08893

#### FRAME FOR A SEMI-PERMEABLE MEMBRANE ASSEMBLY.

Rhone-Poulenc S.A., Paris (France). (Assignee) Y. Butruille, and J. Mourlan.

U.S. Patent 3,805,960. Official Gazette of the U.S. Patent Office, Vol 921, No 4, p 1483, April 23, 1974. 1 fig.

Descriptors: \*Semipermeable membranes, \*Patents, Equipment, \*Membranes.

Identifiers: \*Frames.

Frames for clamping together the plane membrane and interposed plates of a semi-permeable membrane stack are described. The frame comprises two frame plates interconnected by tie bars extending from one of the plates to pass through orifices in the other plate. The orifices are countersunk in such a way that the tiebars may be deformed in the orifices to limit subsequent increases in the distance between the two frame plates, so that the semi-permeable membrane stack is held tightly together. (Merritt-FIRL)

W74-08898

#### AUTOMATIC VALVES, PARTICULARLY FOR USE WITH FILTERS.

Engineering Components Ltd., Liverpool (England). (Assignee)

J. C. Cullis. U.S. Patent 3,807,561. Official Gazette of the U.S. Patent Office, Vol 921, No 5, p 1909, April 30, 1974. 1 fig.

Descriptors: \*Patents, \*Valves, \*Filters, Equipment, Filtration, Waste water treatment.

An automatic valve of the poppet or mushroom type is described for use with a filter. It is molded as an integral unit from glass fiber reinforced nylon and has a head and a stem consisting of two parallel limbs formed at their free ends with lateral hook-like projections. The limbs can be pressed together to enable the projections to pass through a port in a ported member. They then can be allowed to spring back to their normal configuration, engaging a spring interposed between the projections and ported member. (Merritt-FIRL)

W74-08900

#### FEASIBILITY STUDY OF HYDROCYCLONE SYSTEMS FOR DREDGE OPERATIONS.

Oklahoma State Univ., Stillwater. Office of Engineering Research.

For primary bibliographic entry see Field 5D. W74-09202

#### HULAH DAM EMERGENCY BULKHEAD PROTOTYPE CLOSURE TESTS.

Army Engineer Waterways Experiment Station, Vicksburg, Miss. Hydraulics Lab.

W. C. Blanton, J. E. Hall, and D. F. Bastian. Available from NTIS, Springfield, Va 22151 as AD-767 235; Price \$3.50 printed copy; \$1.45 microfiche. Miscellaneous Paper H-73-8, September 1973. 17 p, 11 plate, 1 tab.

Descriptors: \*Gates, \*Spillways, \*Bulkhead gates, Flow control, Gate seals, \*Oklahoma, Hydraulic structures, Dams.

Identifiers: Hulah Dam(Okla).

The emergency bulkhead gate at Hulah Dam, Oklahoma, was tested to determine its effectiveness in stopping flow at various control gate positions. The bulkhead consistently stopped at a position approximately 2 ft above the seat for every

opening of the control gate. Measurements of downpull and acceleration revealed that an average peak hoist force of 22,500 lb occurred with the control gate full open and a bulkhead position of 5.8 to 7.0 ft above the seat. A maximum acceleration of 0.5 g was recorded with the control gate full open and the bulkhead 6 ft above the seat. Emergency closure of the gate under the conditions tested is not possible. (Knapp-USGS)

W74-09205

### 8D. Soil Mechanics

#### FALL AND RISE OF LAGO DEL ORO.

Dept. of Civil Engineering, Knoxville. Tennessee Univ.

For primary bibliographic entry see Field 4A. W74-08751

### 8F. Concrete

#### REVIEW OF PRECAST PRESTRESSED CONCRETE WATER STORAGE RESERVOIRS.

Natgun Corp., Wakefield, Mass. K. O. Hodgson.

Journal of the New England Water Works Association, Vol 88, No 1, p 58-63, March, 1974.

Descriptors: \*Storage tanks, \*Water storage, \*Reservoir storage, \*Concrete structures, Prestressing, Reviews.

Identifiers: \*Precasting.

Precast prestressed concrete water storage reservoirs are discussed. The tanks have a low profile, versatility of installation, require no painting inside or outside, and have low or minimum maintenance requirements. The domed tanks which are more common than flat tops do not have and do not need columns. They do not have to be taken out of service. There are three types of tanks: small tanks in sizes 100,000 to 500,000 gallons of the precast reinforced concrete panel type, with diaphragm, but not wire wound or prestressed; the regular precast prestressed concrete tanks in sizes 500,000 gallons and up, and the concrete domes for existing circular tanks or for circular reservoirs. Exterior architectural treatment is possible for all tanks. (Merritt-FIRL)

W74-08906

### 8G. Materials

#### UNIVERSITY CREDITS FEEDWATER TREATMENT PROGRAM FOR 50% CUT IN BOILER CLEANING WORK LOAD.

National Engineer, Vol 78, No 2, p 12-13, February, 1974. 5 fig.

Descriptors: \*Boilers, \*Cleaning, \*Corrosion control, Costs, Scaling, Alkalinity, Phosphates, Sludge, Control, \*New York, Water treatment.

Identifiers: \*Buffalo(N.Y.).

The treatment program for boiler feedwater and condensate return lines at State University of New York at Buffalo is described. It is proving effective by keeping three boilers and more than two miles of return lines free of scale and corrosion. The program consists of alkalinity adjustment, phosphate softening, sludge control, iron sequestration, foam control, and return line corrosion control. It is estimated there is a 50 percent cut in boiler cleaning work load. (Merritt-FIRL)

W74-08797

#### TECHNICAL DEVELOPMENTS.

Pipes and Pipelines International, Vol 18, No 1, p 39, November, 1973.

Descriptors: \*Pipes, \*Pipelines, \*Welding, Welded joints, Plastics, Drainage system.

## SCIENTIFIC AND TECHNICAL INFORMATION—Field 10

### Specialized Information Center Services—Group 10D

Identifiers: Magnetic crack detectors, \*United Kingdom.

Technical developments in the pipe and pipeline industry are summarized. An orbital welding machine consisting of an argon arc welding head carrying a tungsten electrode which rotates about the pipe joint was developed by Startrite Designs, Ltd., Gillingham, England. The machine practically eliminates underbead in the pipe bore, so that flow patterns can be considerably improved. An ICI traveling exhibition toured Great Britain to show how pipes made from Propathene, ICI's polypropylene, have solved many industrial pipework problems for drainage and disposal systems. A combined infill/carrier pipe for road and underground drainage was developed from the Turnall asbestos cement pipe of TAC Construction Materials, Ltd., Manchester. A new range of horizontal magnetic particle crack detectors was designed by Vitosonics, Ltd., Current is passed through the test piece to detect longitudinal defects, and magnetic flux generated by a circumferential coil is used for transverse defect indication. (Merritt-FIRL)  
W74-08820

**CORROSION-RESISTANT PIPE AT WALT DISNEY WORLD.**  
Water and Sewage Works, Vol 121, No 4, p 52-53, April, 1974.

Descriptors: \*Sewers, \*Water cooling, \*Water distribution (Applied), \*Florida, Pipes, \*Corrosion control, Pipes, Wells, Water supply.

The chilled water and sewer distribution system buried beneath the ground at Walt Disney World near Orlando, Florida is discussed. The area's high water table and stringent demands for performance resulted in the use of new and unusual corrosion resistant pipe materials. A drainage system keeps the ground stabilized, but pipe inside the trench is often submerged in water. The 24 in diameter Temp-Tite pipe consists of an outer jacket of corrosion resistant asbestos cement pipe, a closed cell polyurethane foam insulation, and an inner core pipe of epoxy lined a-c pipe that carries the water. It is a factory fabricated preinsulated design that does not require expansion joints. The pipe system is connected by ring type joints providing a tight seal and allowing for pipe expansion and contraction. Thrust blocks are required. The pipe is not affected by corrosive soil and does not require cathodic protection. Water supply is plentiful in the Orlando area, and seven wells were built to handle all water needs. (Merritt-FIRL)  
W74-08892

**BORE HOLE SAMPLING OF SATURATED UNCEMENTED SANDS AND GRAVELS.**  
Commonwealth Scientific and Industrial Research Organization, Sydnal (Australia). Div. of Applied Geomechanics.  
For primary bibliographic entry see Field 4B.  
W74-09094

## 8I. Fisheries Engineering

**EARLY LIFE HISTORY AND FEEDING OF YOUNG MOUNTAIN WHITEFISH.**  
Utah State Univ., Logan. Dept. of Wildlife Science.  
For primary bibliographic entry see Field 5C.  
W74-08832

## 9. MANPOWER, GRANTS AND FACILITIES

### 9A. Education (Extramural)

**ENVIRONMENTAL TECHNOLOGY AT NORWICH UNIVERSITY.**  
Norwich Univ., Northfield, Vt. Dept. of Engineering and Technology.  
For primary bibliographic entry see Field 6G.  
W74-08871

**HYDROGEOLOGY IS MORE THAN A CLASSICAL SCIENCE.**  
Wisconsin Univ., Madison. Water Resources Management Program.  
For primary bibliographic entry see Field 2A.  
W74-09090

### 9B. Education (In-House)

**WATER UTILITIES OPERATOR TRAINING: A WORTHY INVESTMENT.**  
Texas Water Quality Board, Austin. Central Operations Div.  
For primary bibliographic entry see Field 5D.  
W74-08879

### 9D. Grants, Contracts, and Research Act Allotments

**GREAT LAKES RESEARCH PROJECT FORECASTS DIRECTORY 1973.**  
National Ocean Survey, Detroit, Mich. Lake Survey Center.  
For primary bibliographic entry see Field 2H.  
W74-09118

## 10. SCIENTIFIC AND TECHNICAL INFORMATION

### 10C. Secondary Publication And Distribution

**ENVIRONMENTAL ASPECTS OF PLUTONIUM - A SELECTED, ANNOTATED BIBLIOGRAPHY.**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 5B.  
W74-08957

**ENVIRONMENTAL ASPECTS OF PLUTONIUM AND OTHER ELEMENTS - A SELECTED ANNOTATED BIBLIOGRAPHY.**  
Oak Ridge National Lab., Tenn.  
For primary bibliographic entry see Field 5B.  
W74-08958

**AN ANNOTATED BIBLIOGRAPHY FOR ECONOMIC EVALUATIONS OF THE AQUACULTURE OF SELECTED CRUSTACEANS AND MOLLUSKS.**  
California Univ., Davis. Dept. of Agricultural Economics.  
W. E. Johnston, and D. W. Collinsworth.  
Available from the National Technical Information Service as COM-73-11568. California Univ., Institute of Marine Resources, La Jolla, Reference No. 74-3, Sea Grant Publication No. 2, August 1973.

Descriptors: \*Bibliographies, \*Aquaculture, \*Economics, \*Shellfish, Mollusks, Oysters, Crustaceans, Shrimp, Crabs, Lobsters, Commercial shellfish.

A selective annotated bibliography of economic data sources and previous economic analyses related to the aquaculture of selected crustaceans and mollusks is presented. While primarily concerned with data related to the Northern lobster, selected references are included for the spiny lobster as well as certain species of oysters, shrimp, and prawns. The bibliography's 111 listings are divided by bibliographies on general aquaculture and specific species, abstracts/indexes, statistical sources, aquaculture, natural fisheries, fisheries with potential for aquaculture, product marketing studies and an author index. (Schroeder-Wisconsin)  
W74-09067

**GREAT LAKES RESEARCH PROJECT FORECASTS DIRECTORY 1973.**  
National Ocean Survey, Detroit, Mich. Lake Survey Center.  
For primary bibliographic entry see Field 2H.  
W74-09118

### 10D. Specialized Information Center Services

**ENVIRONMENT: A BIBLIOGRAPHY OF SOCIAL SCIENCE AND RELATED LITERATURE.**  
Michigan State Univ., Lansing.  
Environmental Protection Agency, Socioeconomic Studies Series Report EPA-600/5-74-011, February 1974, 860 p. Compiled by D. E. Morrison, K. E. Hornback, W. K. Warner. EPA R-801234.

Descriptors: \*Bibliographies, \*Social aspects, Information retrieval, Social impact, Attitudes, Community development, Political aspects, Psychological aspects, Landscaping, \*Environment.

This comprehensive, unannotated bibliography contains nearly 5,000 items covering literature in and related to the fields of anthropology, communications, economics, education, design, geography, history, human ecology, landscape architecture, management, planning, politics and social psychology and sociology. The emphasis is on literature that is substantively, methodologically or theoretically relevant to man and his activities in relationship to natural environments. The bibliography is listed alphabetically by author, with an extensive, crosslisted subject-by-title index under 42 categories: Aesthetic, Humanistic, Literary, Religious, Philosophic; Agriculture, Food, Ranching, Rural; Air; Anthropology; Attitudes, Behavior, Opinions, Motives Values, Perceptions, Cognitions, Knowledge, Psychology, Social Psychology; Built Environment-Natural Environment Interface, Including Urban Environment-Natural Environment Relationships; Climate; Communications, Media; Conflicts, Controversy, Competition, Issues; Conservation, Conservation Movement; Economics, Business, Industry, Economic Growth and Development, Work, Occupations; Education; Energy, Minerals; Forests; General Ecology, General Environment, Social Ecology, Human Ecology, Eco-Systems; Geography, Regional Studies; Government, Public Agencies; History; International, Interstate, Intergovernmental, Interagency; Land; Law, Property Rights; Management, Policy, Decision Making, Planning, Development; Medicine, Health; Methodology, Evaluation, Measurement, Indicators, Systems Analysis, Cost-Benefit Techniques, Projections, Monitoring, Control, Standards, Performance Criteria, Theory, Concepts; Natural Disasters, Natural Hazards; Natural Resources, General; Noise; Place Names in Title; Politics; Pollution; Population, Demography, Migration, Crowding; Quality of Life, Affluence, Living Standards, General Environmental Quality; Readers, Conference Proceedings, Special Issues, Textbooks; Recreation, Leisure, Parks, Wilderness, Wildlife, Nature; Reference; Bibliography.

**Field 10—SCIENTIFIC AND TECHNICAL INFORMATION**

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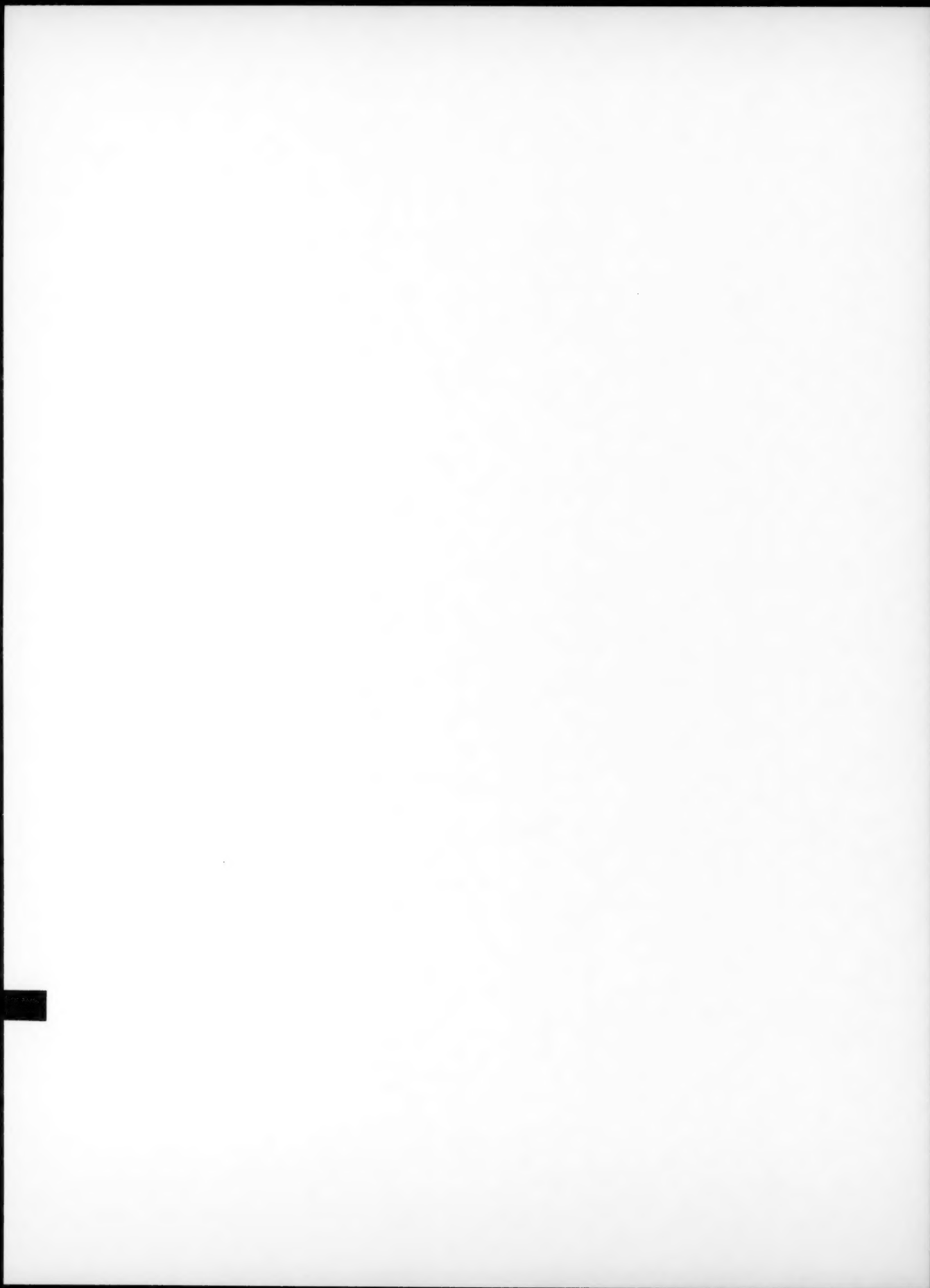
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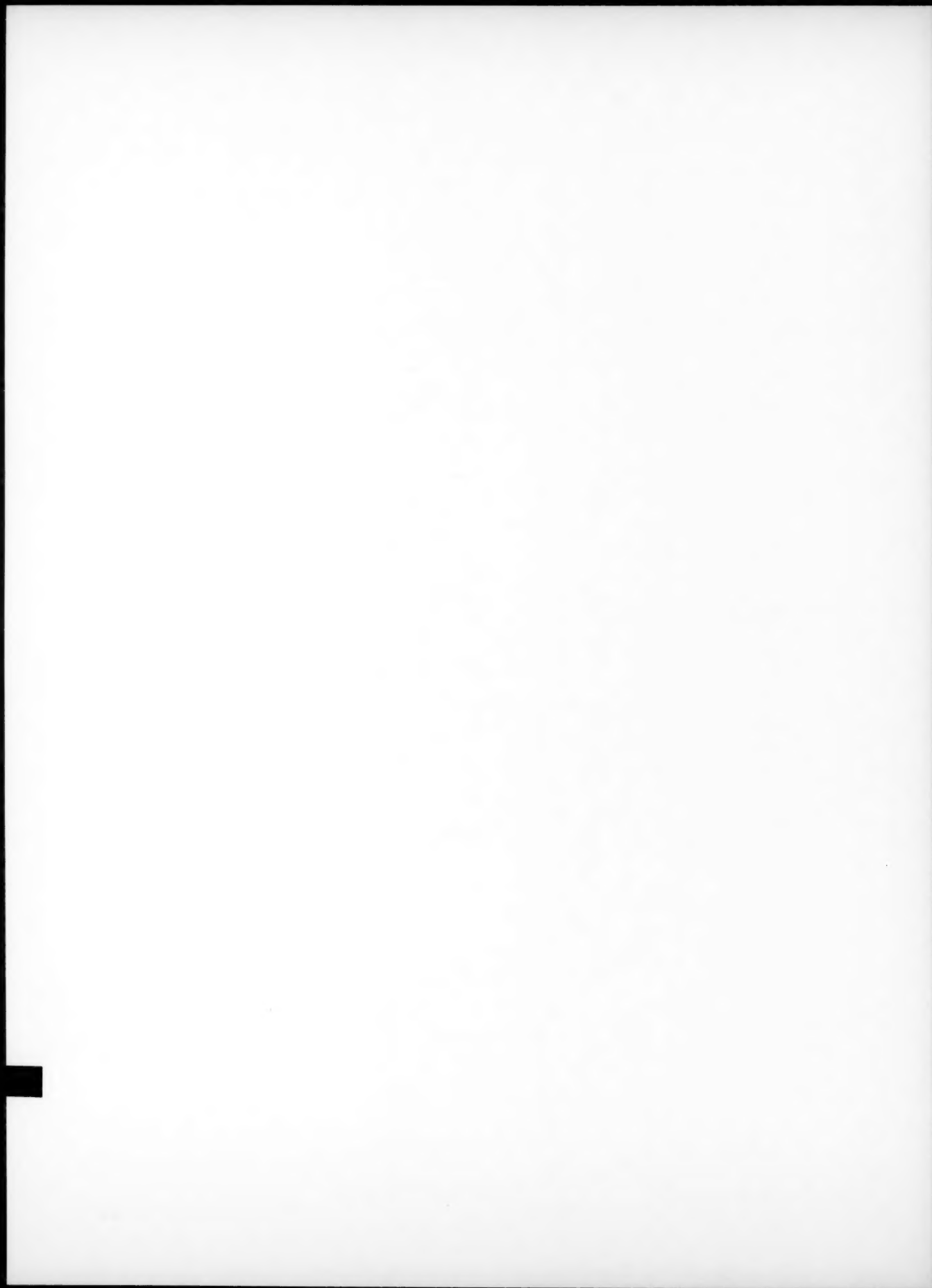
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AEC Oak Ridge National Laboratory, Nuclear Radiation and Safety	W74-08947 -- 08972 09086 -- 09088 09233 -- 09239 09250	37
Colorado State University, Irrigation Return Flow Quality	W74-08799 -- 08819 08917 -- 08924 08926 -- 08932 09248 -- 09249	38
Franklin Institute (FIRL), Municipal Wastewater Treatment Technology	W74-08770 -- 08778 08780 -- 08798 08820 -- 08822 08846 -- 08869 08871 -- 08916	101
University of Arizona, Arid Land Water Resources	W74-08747 -- 08761 08763 -- 08769 08844 -- 08845 09245	25
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U.S. Geological Survey, Hydrology	W74-08703 -- 08712 08823 08973 -- 09048 09089 -- 09118 09193 -- 09231	156
<b>B. State Water Resources Research Institutes</b>		
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New Mexico Water Resources Research Institute	W74-09054 -- 09057	4
Puerto Rico Water Resources Research Institute	W74-08939	1

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Virginia Water Resources Research Center	W74-08701	1
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Environmental Protection Agency (EPA)	W74-08824 -- 08835 08941 -- 08946 09060 -- 09062 09064 -- 09066	24
EPA National Marine Water Quality Laboratory at Rhode Island	W74-08713 -- 08728 08730 -- 08746	33
Ocean Engineering Information Service (Patents)	W74-09174 -- 09192	19
Office of Saline Water	W74-08841 -- 08843	3
Office of Water Resources Research	W74-08933 09058 -- 09059	3

## **CENTERS OF COMPETENCE AND THEIR SUBJECT COVERAGE**

- Ground and surface water hydrology at the Water Resources Division of the U. S. Geological Survey, U. S. Department of the Interior.
- Metropolitan water resources planning and management at the Center for Urban and Regional Studies of University of North Carolina.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Center of the University of Wisconsin.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.
- Water well construction technology at the National Water Well Association.
- Water-related aspects of nuclear radiation and safety at the Oak Ridge National Laboratory.
- Water resource aspects of the pulp and paper industry at the Institute of Paper Chemistry.

### **Supported by the Environmental Protection Agency in cooperation with WRSIC**

- Effect on water quality of irrigation return flows at the Department of Agricultural Engineering of Colorado State University.
- Agricultural livestock waste at East Central State College, Oklahoma.
- Municipal wastewater treatment technology at the Franklin Institute Research Laboratories.

## Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION  
AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT  
AND CONTROL
- 5 WATER QUALITY MANAGEMENT  
AND PROTECTION
- 6 WATER RESOURCES PLANNING
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